Sierra Club

To explore and enjoy the mountain regions of the Pacific Coast; to publish authentic information concerning them; to enlist the support and coöperation of the people and the Government in preserving forests and other natural features of the Sierra Nevada

JOHN MUIR, President 1892 to 1914

OFFICERS AND COMMITTEES FOR THE YEAR 1949–50

BOARD OF DIRECTORS

LEWIS F. CLARK . . . . . *President*

HAROLD E. CROWE . . . . . *Vice-President*

RICHARD M. LEONARD . . . . . *Secretary*

ROBERT L. LIPMAN . . . . . *Treasurer*

FRANCIS P. FARQUHAR . . . . . *Fifth member, Executive Committee*

ANSEL ADAMS PHIL S. BERNAYS ARTHUR H. BLAKE DAVID R. BROWER

GLEN DAWSON WELDON F. HEALD ALEX HILDEBRAND OLIVER KEHRLEIN

NORMAN B. LIVERMORE, JR. CHARLOTTE E. MAUK BESTOR ROBINSON

HONORARY PRESIDENT: JOSEPH N. LECONTE

HONORARY CHAIRMAN OF THE BOARD: WILLIAM E. COLBY

HONORARY VICE-PRESIDENTS

HORACE M. ALBRIGHT, NEWTON B. DRURY, RANDALL HENDERSON, JOEL H. HILDEBRAND, WALTER L. HUBER, DUNCAN MCDUFFIE, FREDERICK LAW OLMSTED, MARION R. PARSONS, ROBERT G. SPROUL, WALTER A. STARR, WILLIAM H. WRIGHT.

COMMITTEE CHAIRMEN

Conservation: ARTHUR H. BLAKE; *Editorial:* DAVID R. BROWER; *Library:* ALFRED E. WEILER; *Lodge:* RICHARD N. BURNLEY; *Membership:* CICELY M. CHRISTY; *Mountaineering:* MORGAN HARRIS; *Natural Sciences:* MILTON HILDEBRAND; *Outing:* RICHARD M. LEONARD; *Visual Education:* KENNETH D. ADAM; *Winter Sports:* EINAR NILSSON.

CHAPTER CHAIRMEN

Loma Prieta: RUBY D. HOWES; *Mother Lode:* FRANK B. DAVISON; *Riverside:* JOE R. MOMYER; *San Diego:* IVY B. FOSTER; *San Francisco Bay:* EMERSON LE CLERCQ; *Southern California:* JOHN W. BANKS.

ASSISTANT SECRETARIES

VIRGINIA FERGUSON CHARLOTTE E. MAUK

Sierra Club Bulletin

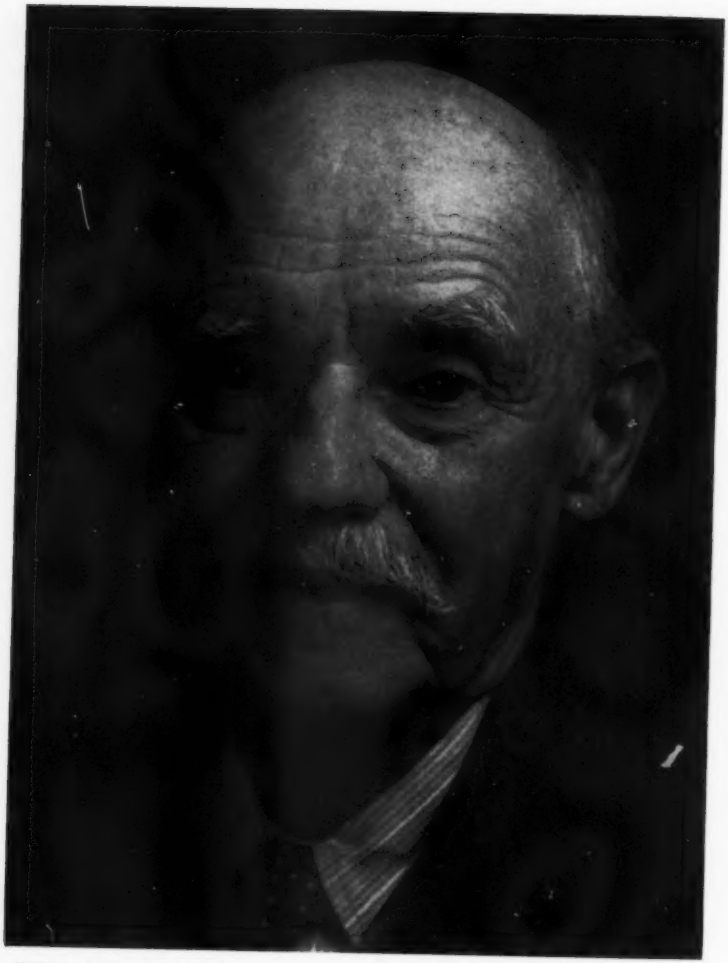
VOLUME 35 JUNE, 1950 NUMBER 6

CONTENTS

FRONTISPIECE AND FORTY-TWO PAGES OF PLATES

Published monthly except August by the Sierra Club, 2061 Center Street, Berkeley 4, California. Annual dues, $6 (first year $12), of which $1 (nonmembers, $2) is for subscription to Sierra Club Bulletin. Entered as second-class matter at Post Office, Berkeley, under Act of March 3, 1879. Changes of address should go to address above; communications on matters of club policy should be addressed to the Secretary, 1050 Mills Tower, San Francisco 4.

Printed in the United States of America by James J. Gillick & Co.



JOSEPH NISBET LE CONTE

Ansel Adams

Sierra Club Bulletin

VOLUME 35 JUNE, 1950 NUMBER 6

Joseph Nisbet LeConte: Some Recollections

By J. S. Hutchinson*

Have you ever read the autobiography of Professor Joseph LeConte (Joseph I), the father of our Joe? You should; it is fascinating reading. In it you can see what a very remarkable man he was and why avenues, schools, buildings, mountains, oaks, and fellowships are named after him. Some excerpts from this autobiography are pertinent to my story:

"Meanwhile, in 1870 our hearts had been gladdened by the birth of the long-hoped-for son. Though I had been well enough satisfied with girls, for they are, I think, the light of a home, we were all delighted that this child was a boy. . . .

"Soon after Christmas, (in 1896) however, I was in Washington to preside at the meeting of the Geological Society of America. . . . Immediately after this meeting I returned South and Mrs. LeConte and I celebrated our Golden Wedding in my daughter's house at Scottsboro, only two miles from Midway, where we were married. Joe having come on from California, we had our celebration in the presence of all our children and grandchildren, as well as of many friends from Milledgeville and Macon. . . . But what can I say of the great reception that followed our return when three or four thousand people crowded into the Hopkins

* Mr. Hutchinson is a charter member of the Sierra Club. He was a director from 1903 to 1907 and in 1903 followed David Starr Jordan as Editor of the *Sierra Club Bulletin* for one year, returning to the editorship for a second one-year term in 1925.

Art Building of the University to welcome us home? There was, of course, the usual hand-shaking and speechifying, and we were presented with a beautiful golden loving-cup."

I am purposely calling attention to the beautiful golden loving cup for it held an important position in Joe's life. It is a perfectly beautiful thing, a triumph of the goldsmith's and jeweler's art. On one side is engraved, in beautiful script, "To Professor and Mrs. Joseph LeConte from the University of California, 1847-1897. Fama semper vivat." On the opposite side is embossed the Great Seal of the State of California. This beautiful loving cup became Joe's after the death of his parents. It was one of his most prized possessions and it was in use on all festive occasions.

This is not a biography of "Our Joe." If you want such a biography read *Who's Who,* or some encyclopedia of American biography, or the accounts published in all the papers at the time of his death; read the notices which will appear in the records of the American Society of Mechanical Engineers, the American Association for Advancement of Sciences; those published by Phi Beta Kappa, Sigma Xi, and other honor societies; also the journals of the American Alpine Club and the Appalachian Mountain Club.

If you want his autobiography, particularly that relating to the high mountains, read the *Sierra Club Bulletin* commencing with Volume 1—he was a Charter Member—down to the most recent—he was made the club's Honorary President in 1931 and he made a valuable contribution to the *Bulletin* as recently as 1941. You will marvel at the interest shown by him in the club during that long period of fifty-eight years of membership. Then besides this splendid autobiography, read his diary of his first real mountain trip, with three college companions, into the then almost unknown regions of the Sierra—"Journal of a Camping Trip Amongst the Highest of the California Sierra—1890." This diary might well be called "A Saga of the Sierra." It is in the Sierra Club Library. Besides he kept a diary of every single trip he made into the mountains; there are forty-four of them. Some day, someone should publish these.

I have taken many trips with Joe. On many of these trips I have often felt as though I was his man Friday; I was always learning so much from him and doing the best I could to help him. When he was measuring the movement of the Nisqually Glacier on Mount Rainier he set up his transit and directed me where to drill a long line of auger holes in the ice. I helped him carry his transit and his plane table to the summits of many high peaks in the Sierra when he was making observations and rechecking locations for his valuable maps of the Sierra. When he made the sur-

vey of the Sierra Club property at Tuolumne Meadows I was with him to help him by holding the rod and by locating the old corners and blazes. We had lots of fun.

About two weeks ago I discovered a gold mine. I was examining the books in Joe's library in his Carmel home and found among his diaries a bound volume, typed by himself, entitled, "Recollections: A Few Notes Descriptive of a Happy Life." It bears the date May 1, 1942. I wish I had found it sooner, for much of it might well have been substituted in place of what I am writing. Even now I must quote from it. It covers all the high spots from the time his father and mother came to California in the Fall of 1869 down to May 1, 1942. It tells of his childhood days in Berkeley when they lived in a university cottage, where the Faculty Club now is; of his school days, his young friends and playmates, of the prairie lands between the University and the Bay, of his hunting in the hills, of his University studies, his student life, his graduation, his year at Cornell on the LeConte Fellowship, which had just been established in honor of his father and his Uncle John; of his connection with the teaching force and the faculty; of his great fondness for the very best music; and it tells of his first Sierra experience:

"In the summer of 1874 (he was four years old) my father took . . . mother and me to the top of Mt. Tallac and this I remember quite well. We went on horseback to Gilmore Lake, I riding on the saddle in front of my father. At this beautiful mountain lake we put up for the night in a small house, and next day climbed Mt. Tallac, my father carrying me in his arms most of the way. This was my first ascent of a Sierra Peak."

Farther on Joe refers to his marriage, in 1901, to Helen Gompertz, his childhood friend and mountaineering companion on many trips:

"After the wedding we went to the grand old Palace Hotel in San Francisco and next morning took the train to Fresno, then by stage to Millwood and went to Kings River Canyon for a honeymoon in that glorious place. We made camp on Copper Creek just above Kanawyer's Cabin and spent a happy four weeks there during which we knapsacked it to the western base of Mt. Brewer and on the next day ascended the grand old mountain. On July 8th we packed our good mule Blackie and started for Paradise Valley, intending to ascend Arrow Peak and map the region to the North. The night of the 8th we spent at Woods Corral at the top of the steep zig-zig and next day bore to the east and crossed the Buck Range and descended into Paradise Valley. We had just finished our dinner when we saw a horseman approaching across the meadow. It was young Poly Kanawyer, son of our good friend in the Kings Canyon, and

as he dismounted he said to me "I'm bringing you bad news. Your father is dead." He told that the death had occurred three days ago, on the 6th of July and that he had ridden clear in from Millwood to Paradise Valley, a distance of 50 miles, without stopping. We gave Poly supper, some blankets to sleep in (for he had nothing) and next morning struck out for Kings River Canyon leaving Poly to drive the mule."

I believe the two very high spots in Joe's mountaineering in the Sierra are the ascent of the North Palisade and his working out of the High Mountain Route.

He had often said to me that the region of the Palisades was the wildest and most rugged part of the whole Sierra. He had climbed Split Mountain (South Palisade) with his wife Helen in 1902. The North Palisade was still a very definite challenge to him. Finally—1903—we were camped at Lake Marion: Joe, Helen, Jim Moffitt, Bob and John Pike, and I. We were now within striking distance of the North Palisade. Leaving Helen and Bob in camp, the rest of us started on a knapsack trip across country to the North Palisade. We camped in Palisade Creek and next day started to climb the peak. We went up to the main crest with the idea of working north along the knife edge, but on arrival considered this to be unsound. So we all climbed Mount Sill. The next day, Joe, Jim Moffitt, and I reached the summit of the North Palisade by another route and let out a mighty shout of joy. Joe gives further details in his memorable article in the 1904 *Bulletin.*

A few years later—in 1907—Joe was asked by the American Alpine Club to write an article on "The High Sierra of California," for their very first publication of *Alpina Americana.* He did so, proud to have been asked. It contains some of his very beautiful photographs and is a splendid piece of work.

The High Mountain Route was something Joe had had in mind for a long time—a pack-animal trip from Yosemite to Kings River Canyon, along a route as near the Main Crest as possible. Theodore S. Solomons had covered part of this route. Finally, in 1908, Joe asked Duncan McDuffie and me to go with him. Joe wrote about this in the *Sierra Club Bulletin* for 1909. This was a marvelous trip and he loved to talk about it. The real tough parts were from Mammoth Pass to Fish Creek, from what is now known as Muir Pass down to Little Pete Meadow, and from Palisade Creek to Cartridge Creek.

In his "Diary, 1908" he describes this trip down from Muir Pass. Nobody had been over before, not even the sheepmen: "On July 18th we were up at ten to four and off at 5:30. We first passed the lake and

crossed the creek at its head. Then continued on up the creek on its west side to the outlet of Crystal (Wanda) Lake, and then crossed again. There was no serious trouble to the summit of the pass over the Goddard Divide (this pass is now Muir Pass). Puss (one of our mules) floundered in the snow at one point but got out without unpacking. From the summit down to Kings River side the going was very rough. We took the mules across talus slopes and down the bed of the creek. Ate lunch at 11:30 when we thought the worst was over, but after that had to go down 1,000 feet of talus. In the river canyon again the going was rough. We had to cross the river four times to avoid cliffs and huge talus. Finally made a large meadow by 3:30 and camped for the night. It was a beautiful camp and we had a fine dinner." This meadow is Little Pete Meadow and the Canyon now appears on the Geological Survey maps as LeConte Canyon. Joe wrote, "This was one of the most glorious trips that I ever took in my life."

When Joe and I would get together we would frequently trade a lot of "Remember when's" but I will only give you just one of the anecdotes, which relates to the Sierra.

In 1913 Joe, Charles Noble, my nephew "Din" Hutchinson and I were camped at Bullfrog Lake. One afternoon I said "I've often looked down to Independence from the pass, but I've never been down over that trail and I'd like to go." Din said at once, "I'll go with you." Charles was noncommittal but showed favorable signs. Joe said, "I've been over that trail many times, I'll keep camp if you fellows want to go." I knew that Joe liked beer, so around the campfire I said, "Joe, if you'll go down, I'll buy beer for all." Joe dreamed of beer that night and next morning early he said he'd decided to go down with us.

We packed two of our four burros with sleeping bags and dunnage rolls. The other two we staked out in the meadow and started. When we reached the pass we got that wonderful view down and down, 8,400 feet, to the desert and Independence, first the snow fields, then Pothole Lake, then some trees, then sagebrush and desert. We crossed the pass and went down the other side. "The snow ran out in flowers and the flowers turned to aloes, and the aloes sprung to thickets and a brimming stream ran by; but the thicket dwined to thorn-scrub and the waters drained to shallows and we dropped again on desert, blasting earth and blasting sky."

In the clear desert atmosphere Independence looked to be within a stone's throw, but it took us hours to reach it. At four o'clock we were at its outskirts, on the one main street with its dingy cottages. With

shouts of joy we greeted the sign hanging over the porch of a ramshackle saloon. We hitched our two burros to the rail, climbed the steps to the rickety porch and entered. Behind the old mahogany bar were some shelves stacked with empty liquor bottles, and behind these was a huge fly-specked mirror. We all lined up at the bar, put a foot on the iron rail and said: "Beer"! "We ain't got no beer. We got soda water." "Where can we get beer?" "You can't get beer." "How come?" we asked. "Local option; prohibition." We took soda water.

That night we could have slept in the hotel but the rooms were close and stuffy. We were directed to the city park as a place to sleep. It turned out to be an open square with a pile of cordwood in the center and no trees; but we all laid out our beds there, finding it windy and not too pleasant. Presently Joe said he was going up to the end of a cross street to sleep.

Next morning at dawn we saw Joe coming past our park, laughing vehemently. I said: "Joe, what's the matter?"

"I met the meanest man last night I ever saw or heard of," he said.

"Why?"

"I went up to the end of this blind street, to where it ends in the desert and sagebrush, laid down my sleeping bag in the weeds and grass beside a picket fence, all overgrown. I was nearly asleep when I heard a noise, looked up and there was a rough-looking man looking down at me. He said: 'What you doing here?' I said: 'Sleeping.' He said: 'That's a Hell-of-a poor place to sleep.' I said: 'I've slept in better places.' He said: 'This is my property.' I said: 'How far out?' He said: 'Out to the edge of the sidewalk,' pointing to an imaginary line in the grass and weeds. I gathered up my bag and moved out a short distance and said: 'Is this the street?' He said: 'Yes, but it's a damn poor place to sleep.' I said: 'It's good enough for me tonight' and went to bed."

The next day we made the long pull back to Bullfrog Lake. Somehow everyone was satisfied with the trip.

Just as soon as their two children, Helen and Joseph, were old enough Joe and Helen began taking them on camping trips in the Sierra. I was with them on all of these trips; at Joe's delightful camp in Yosemite in a bend of the Merced River; at that wonderfully beautiful spot at Porcupine Flat; in Tuolumne Meadows, and many other places. We took the children on their first high mountain climbs, Dana, Hoffmann, Unicorn Peak, Mount Lyell.

They both called me "Uncle Jim." This was a misnomer but I liked it. I called Helen "Sweetheart." It was not a misnomer and she didn't seem

to mind it. I called Young Joseph, "Jo-Jo, the Dog-Faced Boy" and he liked it. It *was* a misnomer. Jo-Jo has a lovely wife, Dorothy, and two fine boys, Joseph IV and John II. Joseph IV, although quite young, has already been camping with his father twice at Porcupine Flat. John is still too young to go but he cries because he can't go. The LeContes are certainly a race of hardy mountaineers. They inherit it.

My last Sierra outing when Joe's wife, Helen, was with us was at Porcupine Flat in 1924. We were with a number of other friends, including Adelaide Graham, a classmate and California graduate with Helen—a long-time and very warm and intimate friend of the whole family. Helen had been ailing on and off for several years and this time the altitude was too high for her and she had to return to Berkeley, Adelaide and Joe returning with her. Adelaide remained with her, caring for her for a long time; but Helen died on August 26th.

Joe and Adelaide Graham were married February 16th, 1929. "By the Summer of 1930," Joe said, "I saw Adelaide could stand a Sierra Pack trip so we made one last grand trip to the Kings River Canyon, Simpson Meadow, Grouse Valley, and Kearsarge Pass, where Adelaide climbed Mount Gould, 13,001 feet."

"On this trip," writes Joe in his diary, "as on those of the last two preceding years I was troubled again with aching and numbness in my feet when walking. In the fall I began to have heart pains when exercising violently or walking rapidly. I saw that it was all off, and my doctor and my common sense told me that there were no more High Sierra packing trips for me. There could be nothing more strenuous than an automobile trip to the Ski Club. So that 1930 trip was my last, but nothing can ever efface the memory of those forty-four glorious Sierra trips. Those are something that can never be equalled. I kept a diary of each year. Some are mere notes of a line or two each day, some are completely written out as those of 1887, 1889 and 1890, but I have them all typewritten and bound on my library shelves."

As I have said, Joe prized his golden cup most highly and each year on his birthday, February 7th, or on New Year's Day he would bring it out from the safe deposit vault and invite many of his friends to his home to celebrate. There would be a huge punchbowl full of George Washington punch made by Joe from a recipe which his father had obtained ages before from Mount Vernon.

On such occasions Joe was always at his best and his guests would insist that he recite some of their favorites: Bret Harte's, "I reside at Table Mountain and my name is 'Truthful James' " or "The Heathen Chinee"

or "The Origin of the Banjo," a story handed down to him by his father. Or best of all, he would read "The Minute Man" from *A Parody Outline of History*. He would give a wonderful performance.

In 1937, after he had been teaching forty-five years in the University he became emeritus professor. He resigned owing to his failing eyesight. His life was wrapped up in the University and he felt sad about his retirement. He said to me at that time: "Jim, I haven't accomplished much in the world but I've done the best I could." This from a man who for forty-five years was recognized as the very best of teachers and upon whom his Alma Mater had gratefully bestowed an honorary degree!

I last saw Joe on February 1st. My daughter and I went down from Berkeley to see him. As we entered his room his eyes were closed. I went to his bedside and said: "Joe, here are Jim and Marjorie." He opened his eyes and held out his hands toward us. Adelaide lifted the curtain of his oxygen tent and put on his glasses. He grasped our hands firmly. I began to talk to him, and Adelaide said: "Talk to him about the mountains. He loves that."

I asked, "Joe, remember our climb of the North Palisade with Jim Moffitt?" He looked up at me through his intensely keen and intelligent eyes and smiled. He tried so hard to talk to us. His tongue moved but he could not articulate.

"Do you remember our Mount Brewer climb? Remember your High Mountain Route? You and Duncan and I?" I talked of our camps on the Merced, at Porcupine Flat, at Tuolumne Meadows. All this time he was looking intently at me smiling, his bright eyes full of intelligence and delight. It was a great joy to him to hear about his beloved mountains.

That afternoon Marjorie and I drove back to our Berkeley home. An hour after we arrived the phone rang. It was Adelaide, to say that Joe was gone. This was the earthly end of a great and good man; a man who was fond of his fellow men, who loved his friends dearly, and who was beloved by all who knew him; a man whose influence for good will last long. I loved that man dearly and I know that he loved me.

Engrave on his storied urn:

I've done the best I could.

GLACIER POINT, WINTER

Watercolor by Dorothy R. Mayer

MAY LAKE

Watercolor by Dorothy R. Mayer

Sierra Stars

By BLANCHE STALLINGS

YOU CAN'T do much collecting on a High Trip. Thirty-pound limits, and four-thousand-foot climbs, and Sierra Club educational influences take care of that. However, the fact remains that High Trippers come down from the Sierra with wonderful collections that are just given to them, like Ike Livermore and his collection of passes. That's how I got all these stars. May I spread a few of them out here? Of course, we all know some of them are planets, but for the present purpose it's simpler to call them all stars. Also, we know they really are not Sierra stars, as if the Sierra had its own special stars along with its shining lakes and streams and granite, but are simply our loved star-friends at their sparkling best in a Sierra setting.

First of all, how do you like these large brilliant stars on the black patch of sky? This one group are not High Trip stars, as the rest are, but they are from the Sierra. There are not very many of them because there are too many trees everywhere. It's well up toward Sonora Pass, and it's about two o'clock in the morning. We'd driven up from the city after work, and were so recently removed from artificial lights and pale city stars that these magnificent mountain stars seemed too sublime, too absolutely bright, pure, and perfect to be possible. How could they be accepted? But I looked again, and they were still there, and there was nothing you could do about it, so I simply had to take them.

Next, what do you think of this group—just another skyful of stars? Yes, in a way; but you'll notice there's something different about them. That's because they're not actually stars. They're the reflection of stars in a lake, literally a whole lakeful of stars. It's Sally Keyes Lake, as you know, about ten thousand feet up. Mount Henry is over there across the lake somewhere, but I doubt if you can see much of it now. We saw it for a while at sunset. It had been raining all afternoon, ever since we left Selden Pass. Down across the snow slopes, over the streams and the granite, through forests and flowery meadows, we walked in the rain,

Watercolor by Dorothy R. Mayer

MAY LAKE

then came to the lake. It was gray. The sky was gray. The world was a dripping gray cloud around us and the pine trees. We were pretty wet, but someone managed to keep a big fire burning, and eventually the pack-train came in, bedsites were found, camp was set up, and dinner was ready. Then the storm and the clouds disappeared, and across the blue lake was Mount Henry, purple and gold in the sunset.

The night was wonderfully clear and hushed and stilled after the storm. As someone said, you felt you shouldn't speak above a whisper. Gratefully we dried ourselves in the warmth and glow of the campfire, then decided it was time to be turning in. On the way to my camp I walked by the lake and for some reason stopped, looked down. The lake was clear and still and black as the sky, and full of stars. I wondered if I should tell everyone about it, but concluded that it was no doubt a common Sierra sight. However, I'm glad I took a good look, because in five High Trips since then I don't remember anything like it.

Now we come to something rather dramatic—stars with crescent moons. One of my favorites is this shining silver sliver flanked with a few bright stars above two massive, dark, imposing mountain peaks—Banner and Ritter. It's from a High Trip campfire near Agnew Pass, looking out across the canyon of the middle fork of the San Joaquin. Beyond the depths of the canyon, above snowfields and lesser mountains, Banner and Ritter rise majestically; rugged, powerful, authoritative; contrasting strikingly, yet blending in perfect harmony with the fine, keen light-essence of the stars and crescent moon. It's a cold view. Or maybe it only seems cold because an icy breeze is blowing down the backs of our necks and we remember that over there across the stream our sleeping bags are rolled out beside snowbanks. But that's all right, we like cold views, and it's worth a few shivers any time to see stars and a crescent moon over Banner and Ritter.

Well, we're getting a lot of stars spread out here. One more skyful ought to finish off the display very nicely. It's from a granite ridge on the rim of Chagoopah Plateau, with the Big Arroyo and peaks of the Great Western Divide on one side and everything between Moraine Lake and Mount Whitney on the other.

Having observed the open nature of a certain spot on the ridge and the large expanse of sky and earth to be viewed therefrom, I concluded that it would be a highly desirable place to be at sunrise. With these thoughts

in mind, I eagerly accepted the invitation of two friends to spend the night on the ridge. That very night we left our camp down by the lake, took our sleeping bags up to the appointed spot, spread them out on the granite, and crawled in. What a place for star-work; no lights, no moon, no clouds, just sky and stars. We stayed awake for quite a while, finding the North Star, talking about the constellations, marveling at the Milky Way, thinking and wondering as one does in the presence of stars, then finally dropped off to sleep. From time to time we'd turn over, open one eye to see what was going on, and note that there was a whole new star-pattern overhead.

Just at dawn we awoke, as we had hoped we would. From then on every moment brought something different. The sky became lighter and bluer; the stars quietly faded, then disappeared; the colors changed; the first rays of the sun touched the highest peaks; the shadows moved down the mountains; pine needles became light-needles and the lake came into view. It was day again. We'd come up to see the sunrise, and we saw it, and it was wonderful. But besides that, just think, we had a whole night-ful of stars thrown in for good measure.

"The Great Land"

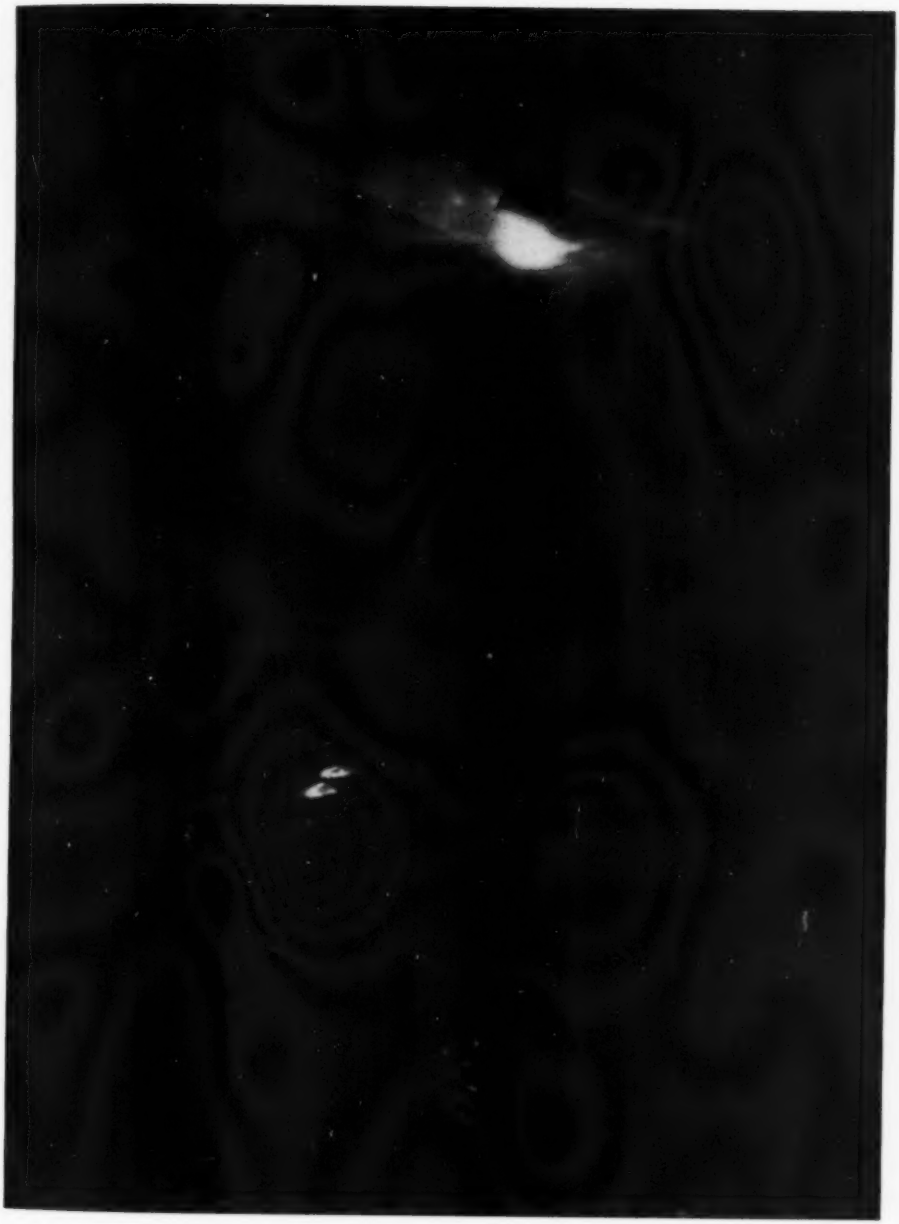
By ANSEL ADAMS

ALASKA, to the average person, is a land of formidable mountains, dreary wastes, ice, Eskimos, fish, rough pioneer life, northern lights, and mosquitoes. It may be much of this; certainly it is infinitely more. Bleak though its immense territory may be, most of it is wildly beautiful —some of it magnificent beyond description. The grandeur of Alaska needs no restatement here; many men have revealed it to us with clarity of pen and camera. While its material resources are of great importance, we should not overlook the vast spiritual resources of this wilderness—one of the great remaining wildernesses on earth.

Exploitation has barely begun—the nature of the country prevents easy violation—and in this situation lies a great opportunity. Right now, before damage is done, a program of functional conservation needs to be set in motion. Whether or not Alaska soon becomes a state, it is imperative that the National Park Service and the Forest Service give careful attention to the supremely beautiful areas of Mount McKinley National Park and of Glacier Bay National Monument as well as to the scenic values of southeastern Alaska as a whole.

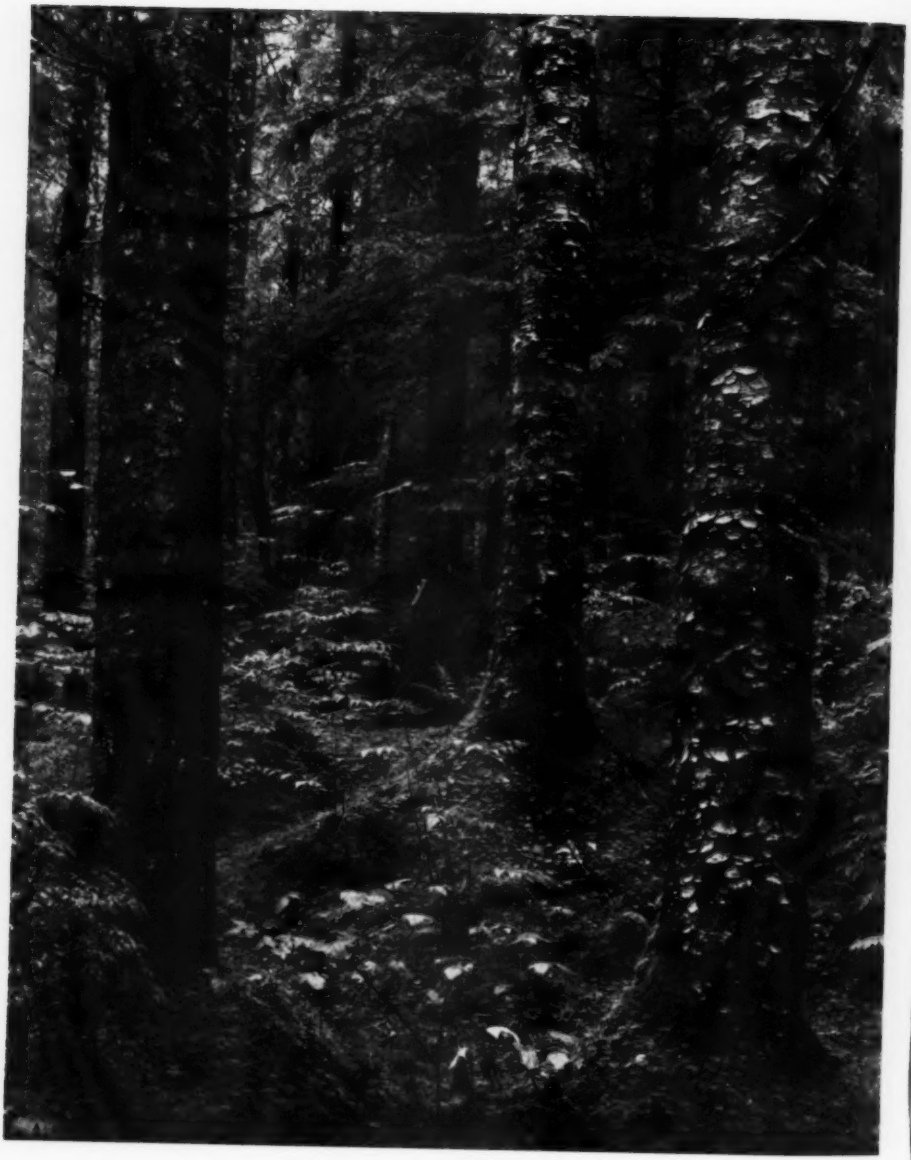
To the photographer the land is an inexhaustible source of exciting images. My own experience is limited to parts of southeastern Alaska and a glimpse of Mount McKinley National Park. After two summer trips I have but touched the vast reservoir of the wilderness spirit of this northern land. In these twelve photographs a certain personal perspective of the Alaska scene is conveyed. They were made under my Guggenheim Fellowship project (photographs of the national parks and monuments). Perhaps they suggest the great beauty awaiting all who come to Alaska.

1. Evening storm, Glacier Bay National Monument.
2. Shorescape north of Juneau.
3. Grass, Bartlett Cove, Glacier Bay National Monument.
4. South Sandy Cove, Mount Fairweather in distance, Glacier Bay National Monument.
5. Rock veins, Glacier Bay National Monument.
6. Mount McKinley, near sunset, from the road to Wonder Lake, Mount McKinley National Park.
7. View upstream on the Teklanika River, Alaska Range, Mount McKinley National Park.
8. Forest, Glacier Bay National Monument.
9. Ancient stump, Interglacial Forest, Glacier Bay National Monument.
10. Margerie Glacier, Glacier Bay National Monument.
11. Mount McKinley, sunrise, from Wonder Lake, McKinley National Park.
12. Mendenhall Glacier and peaks north of Juneau.



TWELVE PHOTOGRAPHS OF ALASKA

by Ansel Adams



The Mountain Mirage

By JOAQUIN MILLER*

I HAVE SET down the following facts, well known to nearly every old gold hunter of the far northwestern States, at the request of my old partner in the express business, T. R. Mossman, now of Seattle, Washington. For my own part, I do not believe in this sort of literature, and feel certain that I could do a great deal better than write stories of this kind, and that you could do a great deal better than read this kind of work. So bear in mind that I do not ask you to read a line of it, or even to believe any more than you can help believing.

It began, this ten days' storm in the Idaho Mountains, with the "small rain" of which the Bible speaks. At first it was only a low cloud that crept away stealthily and white through the black tops of the tall pine trees on the mountainside only a little way above our camp. Then the clouds grew gray and dragged heavily along on the ground and through the long yellow grass of late autumn, as if very weary. Then the clouds seemed to be afraid to go farther on. They began to make familiar with our very beards. They lay low on the grasses and stayed with us all night. They peered in at our tent doors, and we had to keep up big fires and to button up both tent and overcoat to keep dry. At least this was the state of affairs as I found them on my arrival with the express from Walla Walla on my way to Millersburgh, fifteen miles farther on up and in the heart of Mount Idaho, where they were shoveling up gold from the grass roots in the newly discovered Idaho mines as if it had been wheat on a threshing floor.

I wanted to push on that night so soon as I had opened my pack, made fast to keep out the clouds, and delivered the dozen or two letters which I had chanced to have for the dozen or two men whom I found storm-bound here. But the waters were tumbling down out of the tree tops. The earth was filled with water, and was flooding at every pore. It was simply absurd to attempt to force a mule up the steep and slippery mountain before me. It was as much as life was worth to attempt the pass on foot;

* Reprinted from *Lippincott's Magazine*, vol. 47 (February, 1891), pp. 242-247, through the courtesy of the J. B. Lippincott Company and Miss Juanita A. Miller. The account, or story, is based upon Joaquin Miller's experiences in the winter of 1861-62, when he and Isaac V. Mossman (according to John Raine Dunbar in the February, 1950, *Pacific Historical Review*) operated a pony express line in Montana and Idaho. Miller sold out the following spring, using part of his money to buy an interest in the Eugene City *Democrat Register*.—D.R.B.

and although I knew that the rival express, Wells Fargo, with two messengers, was close behind, I reluctantly put up for the night at the hotel tent, kept by Charles Silver, a Jew with a Nez Percé Indian woman for a wife.

At daylight next morning I found the clouds had abandoned the siege and withdrawn to the mountaintops. The air was soft and warm and still. Not a breath. Not even a bird. The air, the earth, and all things of the earth were ominously still, indeed. The clouds lay in pretty white patches, snow-white, above us and all about us in the lifted distance. Through these snow-white rifts and drifts the golden morning sun poured in mellow glory on the mighty mountainsides that rose above the roaring and tumbling river beyond the mouth of the creek where we lay. Our camp, or rather the dozen tents that made up this new town, was close by the mouth of White Bird Creek, made famous as the scene of the first battle in the late war with Chief Joseph, and where many a white man bit the dust.

This White Bird Creek leaps headlong with a hop and a skip and a jump away out into the roaring waters of Salmon River. This river runs into the Shoshonee or Snake River, this into the Columbia, and the Columbia into the Pacific Ocean at Astoria, as you all know.

Now, this Salmon River was, is, and will be to the end of all rivers one of the roughest, swiftest, and ruggedest in all the mountains of Idaho; and that is saying a heap.

Everything had to be carried into the new mines on the backs of either men or mules. The trail twisted and curved and corkscrewed and clung and writhed like a serpent in torment on the rocky and almost perpendicular bluff. It hung in the air along the shelving and sliding banks hundreds of feet above the foaming waters.

If a mule lost his foothold, good-by mule, good-by man!

As for myself, I always got off and walked along here; not unfrequently taking my *cantenas,* especially if loaded with gold, on my own shoulder.

But they were making a new trail—"a tall road," it was called—high above and on better ground. In fact, it was even then completed, all but putting a bridge across the great canyon or cleft in the granite rocks dignified by the name of White Bird Creek, at the mouth of which, as said before, we were now basking in the new morning sun and congratulating ourselves that the storm was over. The new trail was only about half a mile above us, and clearly visible for a long distance.

My mule was at the door, ready. I had weighed out the dust to pay my bill at the tent hotel, and was drawing the cinch tight and strong for

a hard ride, when suddenly down out of the warm sunny heavens there began to tumble hailstones as big as a hen's egg. It lasted only long enough, this cannonade of hailstones, to make my mule break away, but not till I had jerked off my *cantenas* and escaped with their precious contents to cover. Then thunder and lightning!

This lightning struck, struck and stabbed the mountain to the heart right across the river level with our faces and not five hundred feet distant. The dirt and stones and debris flew in the air and rained down in a deluge. The earth simply moaned with pain. The thunder was not thunder. It was the bursting open of the earth. It seemed to be the crack of doom. The cheery lightness that had been only ten minutes before was now all blackness and dismay with seams and streams of lightning. We were blinded and overcome with awe and terror.

The mountainsides, made soft as ashes from the long rain of days before, began to loosen, to roll, to rumble, then tumble headlong into the river. I now could see, or rather hear, how worlds were formed—how river courses in mountains were channeled out, filled up, or forever changed to suit the whim or fancy of the fearful gods of thunder that fashioned them.

"My goodness! My pack train—what will become of that? I told them to take the new trail; and now, my God, they are lost! they are lost!"

This was "Pike" moaning to himself in a corner of the big tent. I never knew any other name for him than Pike. He was a tall, fine-looking man, from Ohio, of middle age, good address, first-class character; and possibly his real name was Pike.

Pike's pack train was the finest on the road—all mules, young and strong, and a fortune to the owner.

This storm did not last ten minutes. It was simply too terrible to last longer. If that storm had lasted ten hours, the world, or at least that portion of it where it lay, would simply have ceased to be.

Even as it was, blocks and patches of the mountain half a mile broad in places had plunged headlong out of place and left only streaming yellow streaks of clay and sand, as if the very bowels had been torn from out the earth.

Then the sun came out almost as suddenly as it had left us. Then a man, the cook, came tearing in, to where Pike was helping me tighten up the letters in my *cantenas*, a precaution against another cloudburst while on my way over the mountain, shouting at the top of his voice, "Pike's pack train! Pike's pack train safe and sound up yonder on the new trail! Come and see, Pike! Come and see!"

Silver, the man who kept the tent hotel, sprang out from behind the bar and started for the door, but his Indian wife, with blazing eyes and wild gesture, caught him and held him back.

My two hands were full just at that moment, but Pike dropped everything and rushed out, to find the whole camp craning its neck up to the new trail, where the pack train, in full view of all, was making good time up around the mountain, as if no storm had ever been.

I heard the men shout and shake hands with Pike and roar out their hearty congratulations. I heard the bell of his bell mule between these outbursts of feeling and good fellowship. Now, mark you distinctly, I heard that bell as clearly as ever I heard any church bell. And indeed I heard that bell more clearly and more distinctly. Because, you see, in my business as carrier of letters I had to know, and know well, the sound of every mule bell on every mile of that road. For much of my riding was done by night. And then often a pack train would be half a mile off the road, for grass or water. And, even if I had nothing for either the master or the men of the train, it was my place to know where every train on the trail was, in order to answer questions of concern to merchants waiting for their goods, and all that sort of thing.

So, you see, I knew that bell of Pike's pack train. I knew the sound, the shape, the size, the quality, the very cost of it. For Pike was my friend, and he had explained when riding with me ahead of his train one day that his bell was the sweetest- and clearest-toned bell on the road because it was largely silver. He now brought the crowd in to drink at the bar. I did not drink, because I never liked liquor in those days; and then, besides that, the boys whose gold I carried had a preference for sober expressmen, whatever they might be themselves. But even as they drank and I completed my packing I heard that bell up above us on the mountain more distinctly than any church bell; I repeat it. For church bells, you know, are much alike, differing mainly not in quality but in volume of sound.

"Well, boy, if you don't look out, Mossman and Miller's Express will be beat by my pack train," said Pike, smiling back over his shoulder at me as he set down his tin cup at the pine bark bar and passed out of the tent.

"I'm off, Pike; good-by." And I hastily threw my *cantenas* on the saddle-pommel and swung my leg across my mule, which had been brought around at the first sign of the sun.

"Say!"

"Say?"

"Tell 'em I'm O.K. and will catch the pack train before it gets to Millersburgh."

"O.K., Pike."

"Hunky dory, Miller."

My mule scrambled up the sliding and slippery hill, and I never saw genial old Pike again, nor even heard of his pack train any more, except only that it was not.

And now a paragraph of digression. I have often seen, as thousands of others have, what is called the Sahara mirage on the sandy levels of Africa. But all that is nothing compared to the weird and wondrous mirage constantly met with on the plains of America.

Not six months ago, a man at Denver, a man whom I knew to be absolutely truthful, told me that he had seen lifted up in the heavens not only entire cities, but had once seen his own house in his own town, although that town was at that moment more than fifty miles distant, with a mountain intervening!

I must admit that I have never seen anything nearly as wonderful as that in all my forty years of the plains, off and on. But I will tell you this: I have seen enough to fill a book full of most marvelous things—things of almost indescribable beauty and glory and grandeur. And the pity to me is that learned and scientific men do not take up this matter and try to explain it a little and let us really know whether these things are of this world or the next.

Now as to this mountain mirage. Why, this mountain mirage is as far above the mirage of the plains as the mirage of the American plains is above the mirage of Sahara. And, too, it is very rare—as rare as remarkable. And when an old mountaineer sees a mountain mirage he is suddenly, and from that day forth to the not distant end of his days, a sober man. And yet some men live a good long time after seeing this sign hung up in the heavens of the Rocky and the Bitterroot Mountains. The only absolute conclusion connected with the tradition is that a man who once sees the mountain mirage must, soon or late, die by violence. But to get back to the trail through the snow over the mountain to Millersburgh.

I urged my mule almost beyond his strength, as I came near the junction with the new jack trail. This was partly because I was a boy and enthusiastic, partly because I was fond of bantering and shouting back in their own tongue to the leather-clad Mexican muleteers, and partly, and no doubt mainly, because I wanted to cheer the black and handsome fellows, after the storm, with the message from Pike.

I kept continually rising up in my stirrups, and now and then leaning

low to look under the long black boughs of pine that hung heavy with snow on the mountaintop. No sign. I kept listening for the clear, soft sounds of the silver bell. It was like death. And my hair stood out with terror and dismay as I came to the junction of the trails and could see not even so much as a track!

I strained my eyes so hard in the snow that day looking ahead, looking back, looking down in the deep narrow trail in the snow before me, that I became snowblind before I reached the express office, and had to be led in by some miners whom I fortunately overtook before entirely losing my sight. This snowblindness is not painful at first. But, oh, the daggers that pierce your sockets the following night!

My older brother, who by good chance was mining at the time there, took charge of my affairs, and the next day came out of the mountains and kept on down with me as far as Lewiston, where I could have medical attendance.

And here, having saved a big bag of gold dust, I sold—or rather gave away—my half of the express line, and never again saw the mountaineers of the phantom pack train. As for the real pack train, it had perished by an avalanche bodily only a few seconds before men saw its shadow in the sun above us.

And now let me tell you what became of the men who saw that mirage. Mind you, I saw nothing—only heard the bell.

That man who came rushing in to tell Pike was the waiter cook of the crude tent hotel. He was killed by a friend of mine, whose name I will not give, from the blow of a hatchet, in that same tent. Pike was shot in the forehead and killed at that place by Matt Bloodsoe only a few days after he saw this phantom train. Bloodsoe, after killing two other men, was killed in Arizona. Si Bradley, killed in Arizona. Alex Carter, hung at Helena. Boone Helm, hung at Butte City. Whiskey Bill, hung at Bozen, I believe. I know he was hung in Montana somewhere, but I am not certain of the place. Cherokee Bob, killed at Florence. Bill Willoughby, killed same time and place. Dave English, Billy Peoples, and Nelson Scott, all hung together by Vigilantes at Lewiston two months later.

I believe there was no other one present at the time the mirage was seen except myself and Silver and his Indian wife. I have been told that my partner, Mr. Mossman, was there; but he asserts, and I know, he was not. It was my business to know where he was, and I know that he was not within two hundred miles. Others, again, say that Arthur Chapman, the famous guide and friend of General Howard all through the recent

Nez Percé campaign, was there at this time spoken of. He was not there, as I well know, but in Walla Walla. He is still living, a most truthful and upright man, greatly respected, and, I believe, still with the army at the solicitation of General Miles, who succeeded General Howard in the Pacific Department.

My old partner Mossman also still lives, and visited me here within the year.

Now, this story of the mountain mirage, as well as all stories of this phenomenon, is rare. You can read, and you can hear tell any day, of remarkable things connected with the mirage of the plains. But a mountain mirage! Well, you will travel far before you will find a man who has seen it. And no man who has not seen it believes in it the least. As for the man who has seen it—well, he is not sociable. At least he is not in the habit of going around and telling people that he is under sentence of death.

As said before, there are better tasks than either the writing or the reading of such stories as this. But back of the request that prompted the setting down of these facts lies the earnest desire for some plain common-sense reason for the mirage, in the valley or on the mountain. Let our learned men answer.

More than a quarter of a century ago, when all this was fresh in my memory, I asked a famous savant in Paris to explain this mountain mirage. He put his head down and his shoulders up, and then slowly balanced his two palms in the air close up under his double chin, as if weighing some weighty proposition; but he remained silent.

Very respectfully, but very earnestly, I again entreated him to tell me what this thing they call the mountain mirage may be. And then, very respectfully and very earnestly, he answered—

"The mountain mirage, it is not. It is impossible."

"Then what was it the men saw?"

"I will tell you, my son." And I bowed my head as he looked me in the face, for he was very serious as he said, in a voice hardly above a whisper—

"Il était un fantôme, mon fils."

The Exploration and First Ascents of Mount McKinley

By FRANCIS P. FARQUHAR

Part II

THE RECONNAISSANCE of Mount McKinley and the earliest attempts to climb it have been discussed in a previous chapter. The results were that by the end of the year 1910 three approaches to the summit had been more or less tried out and claims were extant that both the highest (south) peak and the slightly lower north peak had been attained. The claimants, Dr. Cook and Tom Lloyd, were both widely regarded as liars, although there were some who still believed in Cook despite the conclusive evidence presented against him by Parker and Browne and by Rusk and others of the Mazama expedition of 1910. As for Lloyd, while nobody believed his story, all Alaskans knew that his companions, Taylor, McGonagall, and Anderson, were straight, and, moreover, they knew that they were quite capable of doing what was reported. It took a long time, however, to dissociate Lloyd from the climb and establish the fact that Taylor and Anderson had reached the summit of the North Peak, with McGonagall a participant nearly to the top.

The South Peak of Mount McKinley, highest point in North America, remained untouched, and the now seasoned team of Herschel C. Parker, Belmore Browne, and Merl LaVoy[1] knew it and began preparations for a determined assault. They knew that any attempt to climb the southern precipies was doomed to failure. An analysis of the problem showed that the northeastern ridges offered the most promising line of attack. The obvious approach was from Fairbanks, in winter, with dogs. If this obvious course had been followed it is almost certain that success would have crowned their efforts. At Fairbanks they would have been able to

[1] Merl LaVoy became a news photographer, subsequently specializing in motion pictures all over the world. He photographed Japanese-Chinese military engagements in the 1920's. He had been at Saloniki before that and had photographed Mount Olympus (Thessaly) from the air. Later he was in the Philippines; after that in Italy and in South Africa. I met him in Seattle in August 1912, with Parker and Browne, at a dinner of The Mountaineers. Eighteen years later I met him again at Lone Pine when we rode together on horseback to the summit of Mount Whitney. He was by that time a heavy man for that job, but he made it. He returned to Mount McKinley in 1933 to bring back the body of Koven, killed the preceding year on Muldrow Glacier. In 1925 he became a member of the American Alpine Club. When last heard from he was in South Africa.

winnow facts from Lloyd's discredited tale and they would certainly have arrived at the base of the mountain with ample time and provisions to permit a prolonged effort upon the peak itself should bad weather or difficulties retard them. But they chose another course. They were explorers as well as climbers and they could not resist the temptation offered by a possible new route across the Alaska Range. So they decided to advance once more by the Susitna River and try it the hard way. The resulting exploration was doubtless a great experience and a useful contribution to geographical knowledge, but it cost them the unqualified achievement of the first ascent of Mount McKinley.

1912

The Story of the Parker–Browne–LaVoy expedition has been thoroughly and ably told by Belmore Browne in *The Conquest of Mount McKinley*. His book will always stand out as one of the greatest monuments to American mountaineering literature. Browne is a great painter of mountain scenery and reproductions of several of his paintings enrich the work. To these are added a wealth of illustrative photographs made by Parker and LaVoy as well as by Browne himself. We are, therefore, left in no doubt about where the party went and what they did. It was a fine party of competent men who got along well together. Each did his part, and all came out with great credit. It is a satisfaction to dwell on this, because it more than compensates for the technical flaw in final achievement which must be acknowledged in a mountaineering history. A brief summary of the climb is necessary, however, before we proceed to an examination of this critical point.

Through the late winter the party advanced up the Susitna and Chulitna valleys with their dog sleds, then up into the unexplored mazes of the Alaska Range, until about the middle of April they crossed the divide and worked down to the foot of the Muldrow Glacier. Here they found evidence of another party that had come from Fairbanks to climb the mountain, but soon found that the attempt had been abandoned and the men had gone home.[2] By the end of April a base camp had been established north of the Muldrow and a period of reconnaissance was begun. It was not until early June that the final attack began, and for three

[2] The party comprised Ralph H. Cairns, George S. Lewis, and Martin Nash, and was backed by the *Fairbanks Times*. They made camp on Peters Glacier, scene of the earlier efforts of Wickersham and Cook. Some reconnoitering was done, but delays caused by a blizzard and the insuperable difficulties of the chosen routes forced a retreat. ("Hazards of Climbing Mount McKinley," by Ralph H. Cairns, in *Overland Monthly*, February 1913.)

weeks they struggled up by glacier, snow, and ridge to the basin at 17,000 feet. It was from this camp that they set out on June 29 to try for the summit. The events of the day are told in the following quotations from articles by Parker and Browne written soon after their return. First, from Parker:

On the morning of June 29 at 6:20 we started for the summit in fine clear weather. Our course was directly up the side of the N.E. ridge. Most of the way the grade was steep and we were forced to traverse and cut steps. We reached the top of the ridge in about two hours and a half at an altitude of approximately 18,000 feet. This placed our climbing at about 400 feet an hour. The altitude and our insufficient diet[3] were partly responsible for our slow progress. The views, looking down from the summit of the ridge, were magnificent, and beneath us to the S.E. we could observe the great mass of rugged mountains through which we forced our way on the 1910 expedition . . .

While climbing the ridge the southern sky had darkened and the wind increased in violence.

Ahead of us rose a small snow-dome some 300 feet in altitude, and, climbing this with comparative ease, we reached the foot of the final summit. Here the snow commenced to fall, and from this point upward every landmark was obliterated by the ever-increasing blizzard. The slope was steep and required constant and careful step-cutting.

After perhaps nearly two hours of desperate climbing in the storm, above an altitude of 19,500 feet, we came out on the crest of the ridge and met the full force of the gale. We were possibly at an altitude of from 20,000 feet to 20,200 feet, but we knew that upon the summit were several ridges of snow that rose to a slightly greater elevation. We were in a dangerous position, chilled by the gale, blinded by the snow, and our steps beneath us almost obliterated. After a brief consultation we decided that it was out of the question to go on, and so with the greatest reluctance made our way as rapidly as possible down the summit, out of the storm, and back to camp.[4]

In order to get a more vivid picture of this historic moment, we turn to Browne's magazine articles, which, although different in detail, are in substantial accord with the account in his book:

In the lashing sheets of dry snow I could no longer see LaVoy, and Parker who was only twenty feet ahead, was a dim blur. Realizing our desperate position, I concentrated my mind on getting the blood back into my hands. During the process we were rising slowly foot by foot as LaVoy finished the steps. At times I could no longer see Parker, and I had to feel for the steps with my ice creepers. At last I heard LaVoy's hail above the roar of the wind, and knew that my turn to chop had come. Professor Parker advanced to the steps where LaVoy stood, and when I

[3] They had found the stock of pemmican, upon which they relied heavily, to be indigestible at high altitudes.

[4] In *Alpine Journal,* May 1913, Vol. 27, pp. 193-194. The same article, practically verbatim, is in *Canadian Alpine Journal,* 1913, Vol. 5, and in *Appalachia,* June 1913, 13:1.

joined them we braced against the storm and talked the situation over. Our hard work had come to an end; for just above me I could see between the clouds of snow a small *bergschrund,* or crack, that marked the shoulder of the ridge. I advanced to the lee of this point and as I rose above it I was met by a frozen gale that drove the breath from my body—I couldn't face it. Quickly returning to my companions I told them that we could do nothing at present on the summit. We were in a dangerous place. The summit of the mountain was a horseshoe-shaped ridge about one-third of a mile in length, with the opening facing east. It was uneven on top and from clear views that we had obtained from below, we knew that there was a hummock or small dome rising from the northern bend of the horseshoe summit. This small dome is, in all probability, the highest point on Mt. McKinley. Now we were stormbound on the northern end of the horseshoe curve, where the mountain fell away to join the northeast ridge . . .

Our position was an unique one as I do not believe there is a parallel case in the history of mountaineering. Had Mt. McKinley's summit been a peak we would have swung to the leeward snow slopes and claimed a first ascent. As it was, we were on the summit's edge and but for the extent and formations of this "ridge-summit" we would have claimed the first ascent. We were in the position of a ship that had traveled thousands of miles to reach a certain city and had then been fogbound at the harbor's mouth. This much remains to console us: as far as the climbing was concerned we conquered Mt. McKinley—and when some day a party stands on the highest snow they will have followed our trail to the last dome.[5]

Browne makes two other statements about his position at the point of turning, one in another magazine article and one in his book. In the former he says:

The hummock that formed the highest portion of the summit ridge was only a short distance away and reaching it under good weather conditions would have required no more labor than one encounters in walking along a city street. Our danger was the intense cold and the difficulty of correctly retracing our steps through the storm. But the dome on which we stood *was the summit of Mt. McKinley.*[6]

In the book some of the detail is omitted, but the climax is much the same:

As I brushed the frost from my glasses and squinted upwards through the stinging snow, I saw a sight that will haunt me to my dying day. *The slope above me was no longer steep!* That was all I could see. What it meant I will never know for certain—all I can say is that we were close to the top! . . .

LaVoy said that we had done enough in getting on top of the mountain, and that we had climbed the peak because it was only a walk of a few minutes to the final dome. This was true, but unfortunately there is a technicality in mountaineering that draws a distinction between a mountain top and *the* top of a mountain—we had not stood on *the top*—that was the only difference![7]

[5] *Hearst's Magazine,* December 1912, pp. 48–49.

[6] *The Outing Magazine,* April 1913, pp. 22–23.

[7] *The Conquest of Mount McKinley,* pp. 344, 346.

And that is the consensus of those who have since been to the top—in clear weather. Browne, Parker, and LaVoy were very near the top, but they weren't quite there. It must be a great satisfaction to Belmore Browne that one of those who have been on the very highest point of Mount McKinley, is his son, George, like his father a painter, who made the ascent in 1947.[8]

Ironically, the day following their all-out attempt the summit was clear, but they were in no condition to take advantage of it. The next day, however, July 1, they made a very early start, only to be trapped by another storm well below their former mark. They left a minimum registering thermometer in the rocks of the northeast ridge, sought in vain the next year by Stuck who failed to follow Karstens' reasoning, again sought without success by the Lindley–Liek party in 1932, and once more by the Army testing party of 1942. Nor has it yet been found, but remains a trophy for some future expedition to recover.[9]

Time and provisions had run out. It was necessary to go down immediately. In a few days they were on their way to the Yukon, but not without one last experience of significance to future climbers. Resting at base camp on the evening of July 6, they felt, saw, and heard the effects of a tremendous earthquake. Enormous avalanches fell from the sides of the Alaska Range as they received Mount McKinley's farewell salute.

1913

Both Harry Karstens,[10] pioneer in the Fairbanks-Tanana district, and the Rev. Hudson Stuck,[11] missionary of the Episcopal Church with head-

[8] *American Alpine Journal,* April 1948, 7:1, p. 52.

[9] *American Alpine Journal,* 1945, 5:3, p. 433, and April 1948, 7:1, p. 48.

[10] Henry Peter Karstens was born in Chicago in 1878. He came to Alaska in 1897 and prospected on the Yukon. In 1903 he brought mail by dog team from Gokona on the Copper River to Fairbanks and on to Fort Gibbon at the Junction of the Tanana and the Yukon. This was the first regular mail brought to Fairbanks. For a number of years he was engaged in freighting and mail-carrying by dog teams and launches. In 1921 he was appointed the first superintendent of Mount McKinley National Park and he continued to serve until 1928. He and Mrs. Karstens are now living in Fairbanks. Their son Eugene is a major in the United States Air Force.

[11] Hudson Stuck was born in England in 1863. He came to the United States in 1885, attended the University of the South, Sewanee, Tennessee, and was ordained a priest of the Protestant Episcopal Church in 1892. From 1894 to 1904 he was Dean of St. Matthew's Cathedral, Dallas, Texas. In 1904 he became Archdeacon of the Yukon, with headquarters at Fort Yukon, Alaska. Besides *The Ascent of Denali,* he wrote *Ten Thousand Miles with a Dog Sled,* 1914, *Voyages on the Yukon and its Tributaries,* 1917, and *A Winter Circuit of Our Arctic Coast,* 1920. He died October 10, 1920.

quarters at Fort Yukon, had a growing ambition to climb Mount McKinley. In the spring of 1911, Stuck began to urge upon Karstens a joint expedition, and on December 12, 1911, he wrote to Karstens: "I want you to let me know as definitely as you can whether I may count on you (that is, as definitely as a man may speak about his movement fifteen or sixteen months in the future) in the mountain trip which we discussed together last spring, for which I am beginning to make preparations.[12] My heart is set on this attempt," he continues, "and on having you with me. I should bring my boy Walter, who is a fine strong young fellow, and perhaps another man, though we might consult about that. But I don't think there is anyone who can take your place."

It was to be a partnership enterprise, with Stuck providing equipment and provisions and transportation to the base, while Karstens was to furnish the experience and leadership on the mountain without which Stuck would have been unable to proceed. Stuck had made a few climbs in 1903 and 1904 in the Colorado and Canadian Rockies and had climbed Mount Rainier in 1907, but as events turned out he showed little ability as a climbing leader. Karstens, on the other hand, with no previous high-mountain experience, developed unusual ability and resourcefulness on steep snow and ice and brought the party through several critical passages which required all his strength and sturdiness. In these he was ably supported by Walter Harper, son of the Arthur Harper who, in 1878, had been among the first to see the great mountain from the interior. Stuck says of him: "No more need be said than that he ran Karstens close in strength, pluck, and endurance. Of the best that the mixed blood can produce, twenty-one years old and six feet tall, he took gleefully to high mountaineering, while his kindliness and invincible amiability endeared him to every member of the party."[13] The fourth member of the climbing party was Robert G. Tatum, also twenty-one years old, who was connected with the Episcopal Mission at Nenana.[14] He worked willingly and hard and apparently took over some of the

[12] Letters from Stuck to Karstens, written both before and after the climb, are now in the library of the American Alpine Club, New York.

[13] Walter Harper married a nurse at the Episcopal Mission, Fort Yukon, and was accompanying her for a visit to her family home in Boston when the ship on which they were traveling, the Princess Sophia, was wrecked in Lynn Canal south of Skagway, October 24, 1918, and all on board were lost.

[14] Tatum became an episcopal minister and after a period as rector of a church in Marietta, Georgia, returned to his native city of Knoxville, Tennessee, where he was living in 1932. In that year an interview about the Mount McKinley climb was published in *The Knoxville News-Sentinel*, May 22.

duties that Stuck might have been expected to perform. Stuck says Tatum did the entire cooking for the expedition.

Provisions and equipment were gathered and sent up the river toward the mountain in the summer of 1912, not without many trials and mishaps, and toward the end of March 1913, when the time came to start, they were able to travel light to their first base near the mountain. By April 6 they had reached Lloyd's Willow Camp and on April 10 they set up their base camp about three miles above, at the forks of Cache Creek. A week of hunting, preparing food, fixing equipment, and packing over McGonagall Pass to the glacier followed. Stuck acknowledges the debt they owed to the pioneers of 1910 for establishing the route.

There is an important difference to be noted, however, between the climbs of 1912 and 1913. The earthquake of July 6, 1912, with its great avalanches, so graphically described by Belmore Browne, had converted the comparatively even slopes of the northeast ridge, by which the ice fall of the glacier must be by-passed, into an intricate maze of shattered ice and snow. Karstens describes it in his diary: "Great blocks of ice stand on top of ridge with sheer drop on either side. Other places honeycombed blocks stand over one another which look as though they would tumble over by whispering at them."[15]

They had now been on the mountain for a month. Everything was assembled at the 11,500-foot level and, as Karstens says, "The real climb starts from here." The attack on the ridge began May 8 and it was not until June 3 that camp was finally established in the upper basin, at 17,000 feet, Parker and Browne's highest camp. On June 6 they were at 18,000 feet and ready for the summit. By tremendous exertion, Harper and Karstens bearing the brunt, they had arrived at this record height for an American camp with provisions for a three weeks' siege, if necessary. Far more fortunate than their predecessors had been, and secure against defeat, they were not to need this ample reserve.

The morning of June 7 was cold and clear. The day of opportunity was at hand. Yet, for the two principals, it came near to being the day of denial. Hudson Stuck has told the story in full; Harry Karstens' diary gives it in brief:

> Everyone out of condition last night and no one slept. We tried from 7 to 10, but no go. So we all sat around primus stove with quilts on our backs waiting for 4 o'clock. My stomach was bad and I had one of the most severe headaches. If it were not the final climb I should have stayed in camp, but being the final climb and such a promising day I managed to pull through. I put Walter in lead and kept him there

[15] Karstens' diary is now in the library of the American Alpine Club, New York.

all day with never a change. I took second place on rope so I could direct Walter and he worked all day without a murmur.

It was this heroic work of Walter Harper, backed by the dogged persistence and firm judgment of Harry Karstens, which brought success that day, for Tatum could no more than hold his own, while Stuck was frequently gasping for breath and, in his own words, "had almost to be hauled up the last few feet, and fell unconscious for a moment on the floor of the little snow basin that occupies the top of the mountain."[16]

Nevertheless, the summit was reached, clearly and unmistakably the first complete ascent of the highest mountain in North America. It was a notable achievement in many ways. In the first place it set the pattern for future climbs by starting from the interior rather than from the coast; moreover, it was conducted without deviation with the summit as the sole objective; and, finally, to the great satisfaction of Alaskans, it was an Alaskan affair with a native Alaskan leading to the top and a Fairbanks man the effective leader of the expedition. In the final appraisal the name of Karstens should come first—it should be the "Karstens–Stuck Expedition." In many quarters Stuck has had more than his share of credit, due largely to the fact that it was through his dispatches, articles, book, and lectures that the achievement became known. In fact in the original draft of his *Scribner's Magazine* article, Stuck did not make it clear that Karstens was a partner—this was corrected in the proofs when Karstens' friends began to complain about the first newspaper accounts. Justice has been done to Karstens in one respect: the famous northeast ridge, up which he cut so many steps and bore so many burdens, now carries his name.

[16] *The Ascent of Denali*, p. 99.

Bradford Washburn's Photographs of Mount McKinley

BRADFORD WASHBURN has made many great photographs of mountains, but he is perhaps best known for his work on Mount McKinley. Here he has had unique experience. He has twice stood on the summit of the South Peak; he has climbed the North Peak as well; he has spent many weeks on the Muldrow Glacier and on the snow basins at its head; and he has flown many times close to and around the mountain in the course of an intensive survey of its glaciers and ridges. To Mount McKinley he has brought skills developed on many another Alaskan mountain: on Fairweather and Crillon, on Lucania, Bertha, Steele, St. Agnes, Sanford, Hayes, and on the St. Elias group, as well as on Mont Blanc and other Alpine peaks. In photography he has attained a high degree of perfection, both in the narrative form of the motion picture and in the stationary form designed for study and topographical use. But it is one thing to make a brilliant documentary record and quite another to produce at the same time a work of art which serves to interpret the more illusive aspects of the mountain scene. The photographs of Mount McKinley which Brad Washburn has so generously contributed to this number of the Sierra Club Bulletin are ample evidence both of his skill and of his art.

FRANCIS P. FARQUHAR

FROM THE NORTHEAST, LOOKING UP MULDROW GLACIER.

Mount McKinley from the Air

TWELVE PHOTOGRAPHS BY
Bradford Washburn

All photographs were taken with a Fairchild K-6 Aerial Camera. Lens: Schneider Xenar 4.5. Some were taken with a Minus Blue filter and some with a Number 25 Red filter. Original negative size is 7 × 9 inches.

FROM THE NORTHEAST. TRALEIKA GLACIER AT LEFT; MULDROW GLACIER IN CENTER; McGONAGALL PASS IN CENTER FOREGROUND

FROM THE NORTHEAST. TRALEIKA GLACIER AT LEFT; MULDROW GLACIER IN CENTER; McGONAGALL PASS IN CENTER FOREGROUND

THE TWO PEAKS OF McKINLEY AND KARSTENS RIDGE, FROM THE NORTHEAST.

SOUTHWESTERN APPROACH TO McKINLEY, AT THE HEAD OF KAHILTNA GLACIER.

SOUTHWESTERN APPROACH TO McKINLEY, AT THE HEAD OF KAHILTNA GLACIER.

THE FAMOUS SOUTHEAST FACE AND THE HEAD OF RUTH GLACIER.

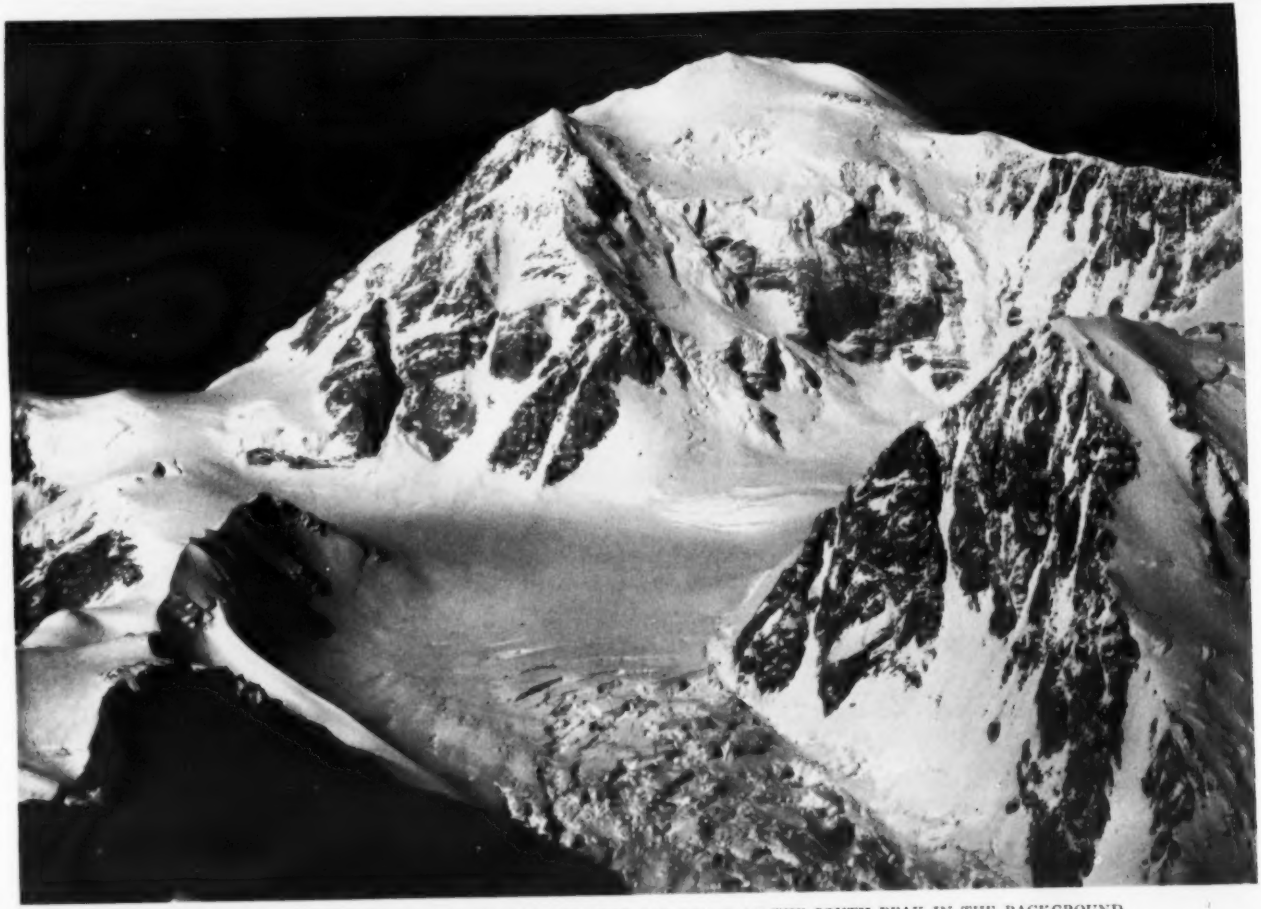
FROM THE WEST, ACROSS THE HEAD OF PETERS GLACIER.

FROM THE WEST, ACROSS THE HEAD OF PETERS GLACIER.

SOUTHWEST FACE AT TWILIGHT.

THE GREAT 14,000 FOOT NORTH FACE. THE TOP OF THE SOUTH PEAK IS JUST TO THE RIGHT OF THE NORTH PEAK.

THE GREAT 14,000 FOOT NORTH FACE. THE TOP OF THE SOUTH PEAK IS JUST TO THE RIGHT OF THE NORTH PEAK.



HEAD OF THE NORTH FLANK OF TRALEIKA GLACIER. THE EAST FACE OF THE SOUTH PEAK IN THE BACKGROUND.

PEAKS AND VALLEYS AT THE HEADS OF RUTH, TOKICHITNA, AND KAHILTNA GLACIERS—AT THE END OF THE GREAT SPUR.

PEAKS AND VALLEYS AT THE HEADS OF RUTH, TOKICHITNA, AND KAHILTNA GLACIERS—AT THE END OF THE GREAT SPUR.

CREVASSES OF UPPER MULDROW GLACIER, KARSTENS RIDGE (UPPER LEFT), AND THE GREAT SERAC (CENTER)

KARSTENS RIDGE (CENTER), HEAD OF MULDROW GLACIER (RIGHT FOREGROUND), AND THE TWO PEAKS FROM THE NORTHWEST.

KARSTENS RIDGE (CENTER), HEAD OF MULDROW GLACIER (RIGHT FOREGROUND), AND THE TWO PEAKS FROM THE NORTHWEST.

A Survey of the Sierra Nevada Bighorn

By FRED L. JONES

Contribution from the Museum of Vertebrate Zoölogy,
University of California, Berkeley.

THE DECREASE in range and numbers of the Sierra Nevada bighorn in the last fifty years has been a matter of concern to various federal, state, and private organizations. In 1941 several interested agencies, in discussing a proposal to establish a mountain-sheep sanctuary in the southern Sierra, concluded that not enough was known of the ecology of the animal to justify setting up such a sanctuary. The proposal was dropped pending accumulation of more information (Colby, 1940; Blake, 1940 and 1941*). In view of the need for a general ecologic study of the Sierra bighorn the present investigation was begun.

A search of the literature was made during the spring of 1948; the findings form the basis for an analysis of the original range of the animal. A field survey was conducted between early July and early December of 1948. This schedule permitted investigation of the sheep during only part of the annual cycle. No data were obtained on the important winter and spring (lambing) periods. Emphasis was placed on present distribution and numbers of sheep, but some additional data on life history, predation, disease, and food habits were gathered.

The field survey covered the crest and eastern slopes of the Sierra Nevada between Cottonwood Lakes basin and the South Fork of Big Pine Creek—roughly sixty per cent of the present occupied sheep range. Independence was the general base of operations. Most of the area along the crest was covered from two base camps—one at Woods Lake and the other five miles north of Foresters Pass. The eastern slopes and the remainder of the crest were reached from various points in Owens Valley.

Upon entering the field I spent two weeks interviewing local residents from Tehachapi to Mammoth Lakes who might have knowledge of the sheep. On the basis of information thus gathered I selected an initial camp at Woods Lake, near where sheep sign was certain to be encountered. It was immediately necessary to become familiar with the appearance of beds, tracks, droppings, and other sign made by the animals before continuing further. The subsequent program of field investigation was designed to cover as much of the occupied sheep range as possible.

* See literature cited, p. 74.

Four of the five occupied units of range were thus surveyed, but time did not permit me to investigate the northernmost unit—Convict Creek.

Vegetation transects were made and evidence of sheep use recorded in order to determine the relative importance of the various alpine plants as forage. Samples of most of the piles of droppings encountered, both old and recent, were taken. A general collection was made of plants which might contribute to the sheep diet. It was hoped that the plant fragments in the droppings could be identified with enough accuracy to supplement the food-habits data acquired from the transects and direct observation.

All place names are on the U.S.G.S. topographical quadrangles covering the southern Sierra Nevada. Such local names as are used are referred to near-by localities listed on the maps.

The entire study was conducted under the direction of Dr. A. Starker Leopold of the Museum of Vertebrate Zoölogy, University of California. I am indebted to Dr. Harold H. Biswell and Dr. Seth B. Benson, both of the University of California, for helpful suggestions in preparing the manuscript; to Dr. Carl W. Sharsmith, of Stanford University, for final identification of the plant specimens; to Dr. Carlton M. Herman, Parasitologist of the California Division of Fish and Game, for assistance concerning internal parasites; to Dr. Robert T. Orr, of the California Academy of Sciences, for use of the Academy's files; to Mr. Arthur H. Blake, chairman of the Conservation Committee of the Sierra Club, for use of the Sierra Club's files; and to United States Forest Service and National Park Service officials for coöperation in the field and for use of their files.

This report was first submitted to the University of California as an M.A. thesis. Detailed records of occurrence and of food habits, not published here, may be found in the appendix to the original thesis, which is on file in the Library, University of California, Berkeley.

PAST AND PRESENT STATUS

Taxonomy

Cowan (1940) recognizes three races, or subspecies, of bighorn in California—a taxonomic arrangement which I follow here. The Sierra Nevada bighorn is considered by Cowan as part of the race *Ovis canadensis californiana*. An earlier classification by Grinnell (1912) separated the Sierra sheep from its northern relative under the name *O.c. sierrae*. Grinnell considered the population of *sierrae* and *californiana* separable largely on geographic grounds; he had little supporting evidence of

physical differences between specimens. Cowan combined the two on the basis of similarity in skull measurements, accepting only three races of bighorn in California instead of Grinnell's four. Though placing the Sierra Nevada sheep in the subspecies *californiana,* Cowan nonetheless acknowledges a tendency toward differentiation: "These sheep [from the Sierra Nevada] cannot properly be referred to either named race [*californiana* or *nelsoni*] and yet do not differ from them to a degree that would justify the recognition of a separate race '*sierrae*' in that area" (p. 556).

Cowan's classification and the general ranges in California of each race or subspecies are as follows:

Ovis canadensis cremnobates Elliot—Baja California sheep, desert ranges of extreme southern part of state.

Ovis canadensis nelsoni Merriam—Nelson sheep, desert ranges of southeast section of state.

Ovis canadensis californiana Douglas—California sheep (including Lava Bed sheep and Sierra Nevada sheep), northeast corner of state and southern Sierra Nevada.

The Lava Bed sheep is now believed to be extinct. The other groups still occur in California, though in reduced numbers. This report is concerned principally with the Sierra Nevada sheep, and for that reason historical records of its occurrence are discussed in more detail than for the other races. The present and past ranges of the three races in California are shown in figure 1.*

History of Races

Baja California sheep (O.c. cremnobates).—The range of this subspecies is mainly in Baja California, extreme southern California forming only the most northerly portion of it. Those animals found in the mountains along the west side of the Colorado Desert in Riverside and San Diego counties, and probably also in western Imperial County, are considered to be of the race *cremnobates* (Grinnell, 1933). To the north and east they intergrade with *nelsoni.*

In a letter written to the California Academy of Sciences in 1933, M. Hall McAllister estimated that there were 200 to 300 individuals of this subspecies in San Diego and Riverside counties. In 1948 it was believed that the total number in the San Jacinto and Santa Rosa mountains of Riverside County did not exceed 75 (Robinson, letter, 1948).

These sheep are considered generally to range at elevations below 4,000 feet on rough, relatively barren slopes (Grinnell, 1933; Robinson, letter, 1948).

Nelson sheep (O.c. nelsoni).—The range of this subspecies extends

* For figures see signature facing page 36.

from the White Mountains on the California-Nevada border in Mono County, south through the Inyo and Argus mountains, through the mountains of western San Bernardino County to the vicinity of San Gorgonio Pass.

They range east of this line in nearly all the desert mountain ranges in eastern Inyo, San Bernardino, and Riverside counties and in all of Imperial County south to about Picacho on the Colorado River. They also range farther east in the desert mountains of Nevada. By far the greatest area of mountain-sheep range in California is occupied by this subspecies.

In the past the Nelson sheep also occurred in the mountains about the Cuyama Valley in San Luis Obispo and Santa Barbara counties. They ranged southeast through the mountains north of the Sespe River and about Pinos to the San Gabriel Mountains of Los Angeles County. They were last reported in 1912 in a letter written to Joseph Grinnell by A. D. Ferguson. This account concerned a few individuals then present in the Sespe Gorge country. At present the western limit of the range of *nelsoni* in this vicinity is the area about Mount San Antonio.

In a survey of the bighorn in Death Valley National Monument in 1938 it was found that the number of sheep had been increasing since about 1933 (Dixon and Sumner, 1939), when the monument was established and protective laws enforced. Before this, and dating back to the 1880s, the sheep had suffered from poaching and disturbance by prospectors. At present they seem to have been restored locally, perhaps to their original numbers.

Over their entire range in California there are estimated to be 1,500 Nelson sheep. This estimate is based on aerial surveys of the desert ranges made in recent years by Don McLean, of the California Division of Fish and Game. Their altitudinal range varies from the floor of Death Valley, below sea level (Dixon and Sumner, 1939), to 14,256 feet on the top of White Mountain Peak, where tracks were seen in the summer of 1948 by Al Noren, ranger on the Inyo National Forest.

California sheep (O.c. californiana).—Two geographically distinct groups of bighorn are included in this subspecies—the Lava Bed sheep and the Sierra Nevada sheep.

The Lava Bed sheep once ranged in the extreme northeastern portion of the state in Siskiyou, Modoc, and Lassen counties. The range extended west into the western half of Siskiyou County, south to the vicinity of Smoke Creek in eastern Lassen County, and north and east into Oregon and Nevada.

These sheep were common on Shasta until a few years prior to 1877, when the last were believed to have died (Townsend, 1887). Extinction was attributed to heavy snows after the sheep had been seriously depleted by hunting. The last bighorn in eastern Siskiyou County died in the winter of 1913 (Moffitt, 1934). In 1922 the sheep on Observation Mountain in eastern Lassen County, numbering about 40, died in deep snow. A band of six was seen in 1927 in the Smoke Creek country of Lassen County according to a letter written by C. O. Fisher to Joseph Grinnell in 1929. This was the last report on members of this group in California. Since then all are believed to have perished.

In past years the range of the Sierra Nevada bighorn extended north at least to the Sweetwater Range, in northern Mono County (Manly, 1916), thence south to Olancha Peak in southern Tulare County.

In the Sweetwater Mountains a reliable resident reported seeing sheep in large numbers in 1882 *(ibid.)*. L. Glass, a local resident, reported having seen one bighorn somewhere in Alpine County in about 1904 *(ibid.)*. On the eastern slopes of Sonora Pass a band of 12 sheep was seen each summer between 1876 and 1878 (Grinnell and Storer, 1924). Manly states that prior to 1916 skulls with horns which did not show very great weathering could be found on many of the high ridges of Mono and Alpine counties. There is an old skull in the collection of the Museum of Vertebrate Zoölogy that was picked up on Sonora Peak in 1911. In about 1940 a Forest Service employee told F. P. Cronemiller, Assistant Regional Forester, of seeing a bighorn skull on Fish Valley Peak, a short distance northeast of Sonora Peak. This was not collected, however. In 1916 Manly expressed the belief that bighorn had been gone from this area for several years.

Bert Carry, forest ranger at Pinecrest, stated that he had seen bighorn on Piute Ridge in several different years between 1929 and 1934. In May, 1949, a party of fishermen reported seeing bighorn sheep on upper Summit Creek. There have been other vague accounts in recent years from this region, but none have been confirmed. I surveyed the Piute Ridge–Granite Dome area in August, 1949, and encountered no sheep or sheep sign. The possibility still exists, however, that there is a remnant herd in this region.

Originally the ranges of the Sierra Nevada sheep and the Lava Bed sheep may have been more or less continuous along the broken country in Nevada east of the Sierra Nevada proper. In several spots in Nevada between the Sweetwater Range of California and Smoke Creek in Lassen County, mountain sheep were encountered by early explorers (Fremont,

1846; Wistar, 1937). In later years skulls have been picked up in this same general area (Cowan, 1940). No records have been found, however, indicating that bighorn ever ranged within the boundaries of California (that is, in the Sierra Nevada proper) between the Sonora Pass and Smoke Creek regions.

Until 1900, or shortly thereafter, Sierra sheep occurred in Yosemite National Park. They ranged chiefly along the main crest and along the Cathedral Range. From skulls found in other localities in the park it is evident that the rams, at least, ranged farther to the west.

In 1898 John Muir wrote that there were still a few sheep left in Yosemite. Bill Guinn, retired packer of Sonora, states that in 1914 he and Guy Scott, State Game Warden for many years, heard that bighorn had been seen somewhere between Matterhorn Peak and Tuolumne Meadows that year. Scott told him that he had heard other reports of bighorn having been seen in the back country of his district in prior years. This is the last account of bighorn in Yosemite.

Old skulls have been found in recent years south of Yosemite in the Ritter Range. There is no way of fixing the date of the last occurrence of mountain sheep in this part of the Sierra, but all remains found have been badly weathered and probably date back prior to 1900.

Farther south, on the drainages of Convict and McGee creeks, sheep are still present. Between this area and the Ritter Range there are no available records of the occurrence of mountain sheep, though presumably they once ranged there.

Between the head of McGee Creek and the Palisade Group there are several old records. Disappearance of the last bands in this area probably occurred in the early 1930s. Sheep were last reported in the Mono Pass (Rock Creek) area in 1915. In 1931 Mount Tom was reported to have about 35 head (Ober, 1931). At about this same time sign was seen on Basin Mountain by Norman Clyde, an experienced mountaineer. In August of 1934 a band of six was seen one mile west of Piute Pass by Art Schober, local packer. In 1935 there were several unconfirmed reports of either sheep or their sign being seen in the country between Table Mountain, Coyote Ridge, and South Lake at the head of the South Fork of Bishop Creek. These are the last records of the occurrence of bighorn between Mono Pass and the Palisades. From negative information gathered during the field work it seems safe to assume that sheep no longer are to be found in this area.

In the comparatively small region between the South Fork of Big Pine Creek and Tinemaha Creek a small band still exists. Between this locality

and Taboose Pass to the south there are no records of sheep ever having occurred.

In 1911 local cattlemen stated that the sheep from farther south did not range north of Taboose Pass (Grinnell, 1912). Individuals no doubt wandered into and through this region from time to time, but evidently no bands permanently resided there.

From Taboose Pass south to southern Tulare County the present range differs very little from former times, at least along the eastern edge of the Sierra Nevada.

The area from Mount Russell south to Mount Langley, including Mount Whitney, has no resident sheep population at present. On Whitney, sheep were reported near the top in 1875 (Wheeler, 1876) and on the west slope in 1930 (Wright, Dixon, and Thompson, 1933). This last was a report of climbers and alluded to four sheep. It is likely that identification of the animals was correct and that the sheep were wandering outside their normal range. Each year, for the last 20 at least, Whitney has been climbed by hundreds of people and this is the only report of the occurrence of mountain sheep on it in 55 years. In 1947 Clyde stated in a letter to Robert T. Orr that he had not seen sheep or sign of sheep in 50 ascents of Whitney. These climbs date from the early 1920s. Old skulls have been found near Mount Irvine, to the southeast of Whitney, and on Crabtree Creek, to the southwest. Though it seems evident that this general area is not part of the regular range of the sheep, they do occasionally wander into or through it.

In former years sheep occurred across the Kern River Canyon on the Kaweahs and in the country to the north and south of them. An old skull was found near Triple Divide Peak in 1921, according to Clarence Fry, former Sequoia National Park ranger, and another near Kern Point in 1940 by Sam Griggs, of Independence. According to cattlemen who operated in this area for many years sheep were more common on Red Spur and at the head of Big Arroyo than elsewhere in the region.

To the south these sheep ranged through the Mineral King area and south to at least Maggie Mountain. Old residents state that in the 1870s there was an estimated 125 sheep in the Mineral King area. As nearly as I can judge they were present in the entire region, Kaweah Peaks to Maggie Mountain, until about 1918. This is the opinion of Guy Hopping, former Superintendent of General Grant National Park. Since then it is believed that sheep have been absent from the entire Kaweah Peaks area.

In all, 260 miles of the Sierra crest was once occupied by sheep, compared to the 170 miles spanned at present—a distance which includes 40

miles of uninhabited gaps. Thus the former range of the Sierra sheep has been decreased by about half.

Interchange of Sierra Sheep with Nelson Sheep

Indians reported that sheep regularly moved back and forth across Owens Valley with the deer before white men came. In his field notes H. A. Carr, of the Museum of Vertebrate Zoölogy, who visited the valley in 1911, quoted local residents as saying that the sheep in the Sierra west of Independence did not cross the valley, while those to the north around McGee Creek did.

In 1913 the Los Angeles Aqueduct was completed, forming an effective barrier to such movement. This is an open, concrete-lined, water-filled ditch which runs south along the west side of Owens Valley from 12 miles north of Independence to 15 miles south of Olancha. A few sheep have fallen into this aqueduct in recent years, presumably while attempting to cross from the Sierra to the Inyo Range (figure 11).

Sheep still are seen, but very rarely, crossing the valley between the Coso and Argus ranges and the Sierra. The region between Olancha Creek on the north, Haiwee Creek on the south, Monache Meadows on the west, and the foot of the Sierra Nevada on the east appears to be an area in which the Sierra sheep and the Nelson sheep still meet. The extent of interchange, if any, is probably slight, for it is not believed that any great number of Nelson sheep wander into this region. Most accounts indicate that those which do visit the Sierra Nevada stay low on the arid eastern slope during the summer months, then return east to the desert ranges in the fall. It is doubtful if any reach the west side of the crest, where most of the Sierra sheep in this region range in summer.

Present Range and Numbers of Sierra Sheep

The present range* is restricted chiefly to the crest of the Sierra Nevada and to the arid eastern slope between Convict Creek and Monache Meadows. At times during the summer months individuals or small bands are found many miles out on ridges running west of the crest. Certain of these ridges are occupied with regularity each year. Figure 2 shows the present range in detail.

Five distinct "herds," or local populations, are recognized, each of which is designated by the name of a prominent geographic feature oc-

* All records found in the literature and the localities of occurrence determined in the field are listed in the appendix of my original thesis (Jones, 1949). The exact locality, nature of record, date of observation, and authority are given where possible.

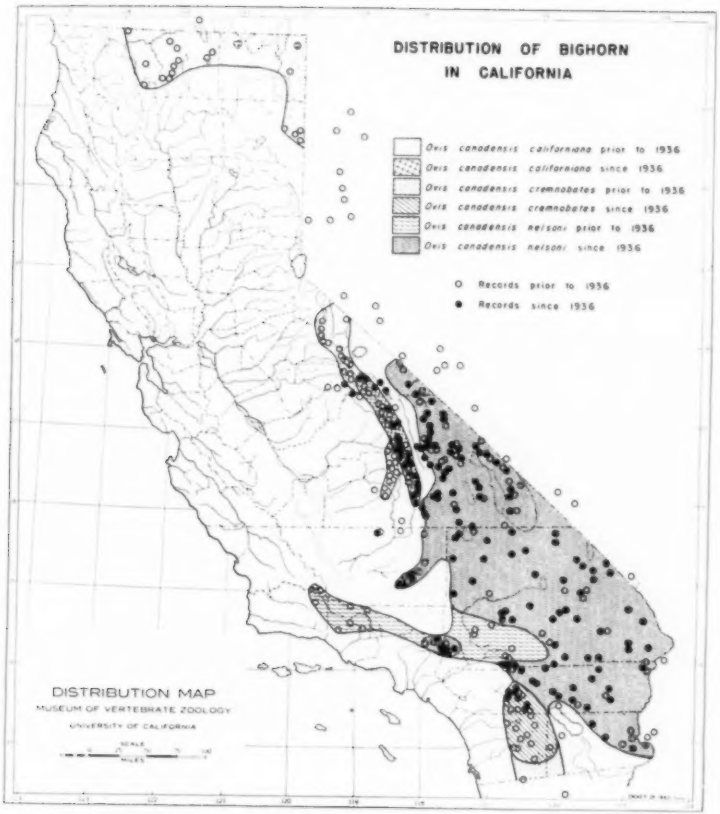

DISTRIBUTION OF BIGHORN
IN CALIFORNIA
Ovis canadensis californiana prior to 1936
Ovis canadensis californiana since 1936
Ovis canadensis cremnobates prior to 1936
Ovis canadensis cremnobates since 1936
Ovis canadensis nelsoni prior to 1936
Ovis canadensis nelsoni since 1936
Records prior to 1936
Records since 1936
DISTRIBUTION MAP
MUSEUM OF VERTEBRATE ZOOLOGY
UNIVERSITY OF CALIFORNIA

Figure 1

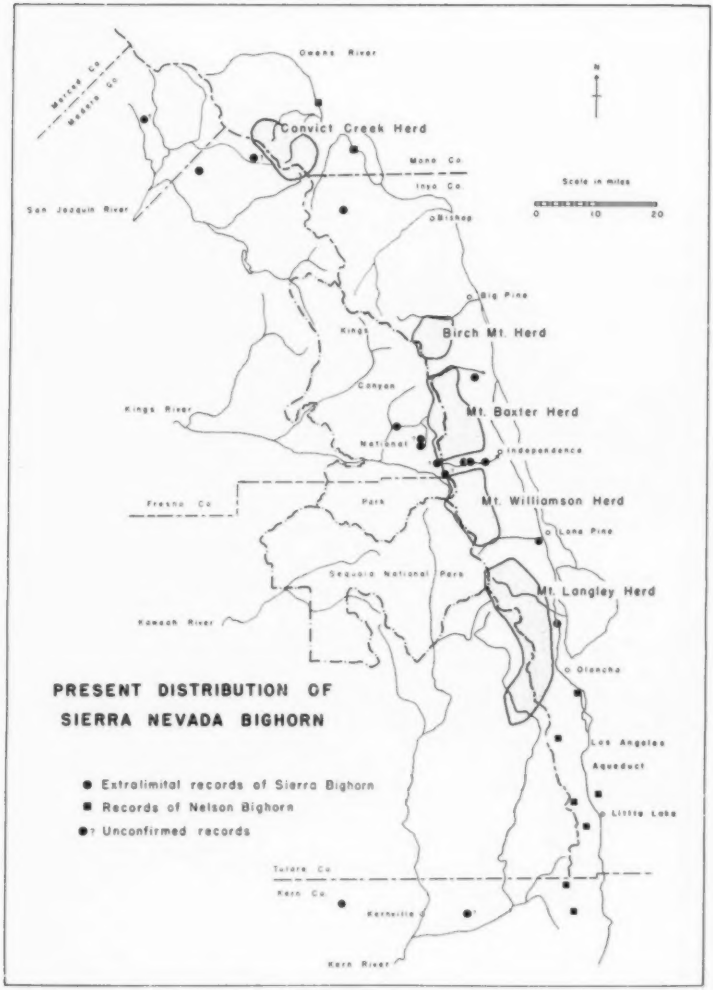

Owens River
Mariposa Co.
Madera Co.
Convict Creek Herd
Mono Co.
Inyo Co.
San Joaquin River
Bishop
Big Pine
Kings
Canyon
Birch Mt. Herd
Kings River
Mt. Baxter Herd
National
Independence
Fresno Co.
Park
Mt. Williamson Herd
Lone Pine
Sequoia National Park
Mt. Langley Herd
Kaweah River
Olancha
PRESENT DISTRIBUTION OF
SIERRA NEVADA BIGHORN
Los Angeles
Aqueduct
Extralimital records of Sierra Bighorn
Records of Nelson Bighorn
? Unconfirmed records
Little Lake
Tulare Co.
Kern Co.
Kernville
Kern River
N
Scale in miles
0
10
20

Figure 2

Fig. 3. East slope of the Sierra Nevada and Owens Valley, from Mount Baxter. August 4, 1948.

Fig. 4. East slope of Mount Baxter, taken from pass to east of Peak 12,206. August 7, 1948.

Photograph in figure 11 is by courtesy of E. L. Shellenbarger. All other photographs by Fred L. Jones.

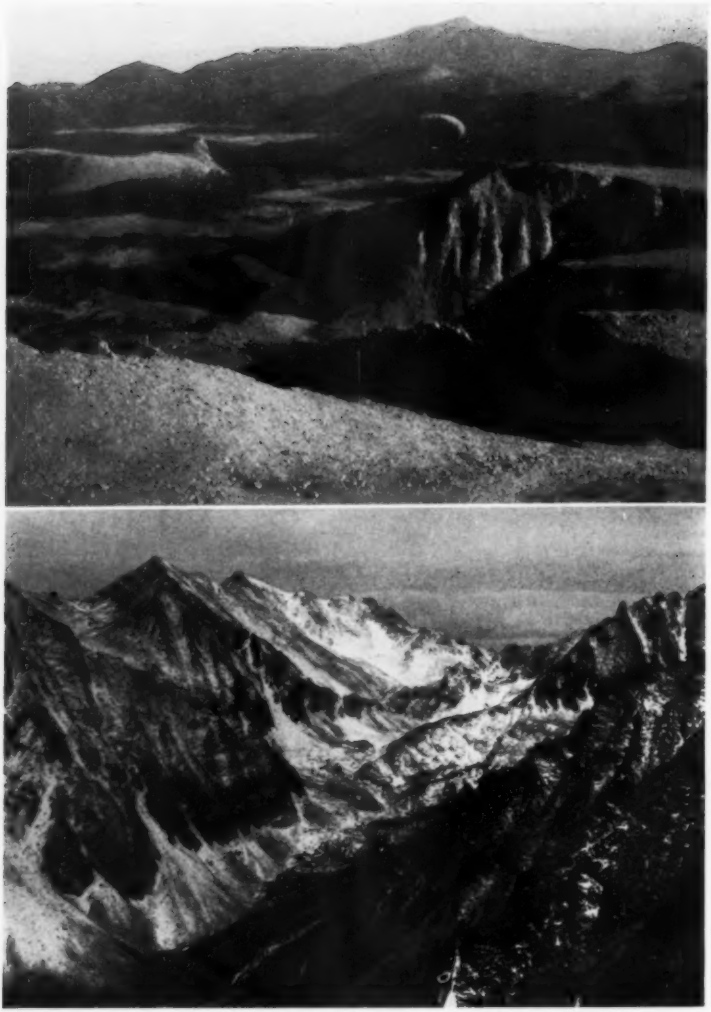


Fig. 5. Sierra crest looking south from Mount Langley. Muah Mountain is at the top and Cottonwood Lakes Basin is in the foreground. October 2, 1948.

Fig. 6. North Fork of Oak Creek, Black Mountain on the left, showing the peaks of the summer range and the rapid melt of snow on the south-facing slopes. Taken from the ridge east of Peak 12,206. October 18, 1948.

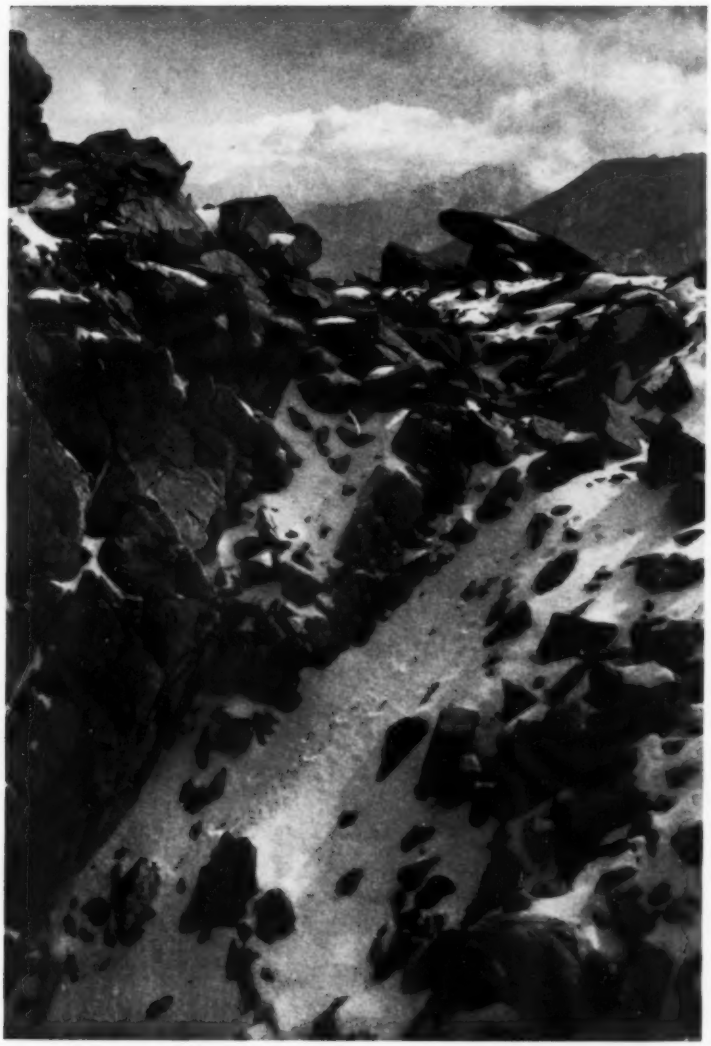


Fig. 7. Tracks of a single sheep ascending a snow-filled chute at the head of Thibaut Creek. October 18, 1948.

Fig. 8. A clear bighorn track in snow at the head of Thibaut Creek, showing characteristic conformation. October 18, 1948.

Fig. 9. Bighorn tracks in mud at the head of George Creek, showing stride and difference in size between forefeet and hindfeet. The one just below the pen is of a forefoot, the one below it of a hindfoot. November 7, 1948.

Fig. 10. A group of bighorn beds on the ridge north of Mount Baxter, showing manner of construction. July 22, 1948.

Fig. 11. Sierra ram taken from the Los Angeles Aqueduct in 1938, showing body proportions and horn tips.

Fig. 12. A band of eighteen bighorn at the head of George Creek at the beginning of the rutting season. Most of the sheep are in a close group to right of center. November 7, 1948.

curring within its range. Each of the herds is composed of several bands of from two to forty individuals. A discussion of each herd and estimated numbers are presented later. The herds in order from north to south are the Convict Creek herd, Birch Mountain herd, Mount Baxter herd, Mount Williamson herd, and Mount Langley herd.

Numbers

Census methods.—The main method of gathering census data was an active search for sheep or sign. As much of the range as possible was systematically covered from peak to peak and canyon to canyon. Additional information was obtained by interviewing all people encountered. No reliable census method was developed that could be used in all parts of the summer range. A complete count of individuals was impossible owing to the precipitous and broken nature of the terrain. On areas where a known number of sheep had been feeding, strip counts of various types of sign—beds, tracks, and piles of droppings—were tried, but these showed little correlation with the actual numbers. The fact that one small band of sheep will heavily track up portions of an area and yet miss other parts complicates sampling techniques of census. However, a rough system based on a total count of beds was found useful in certain areas.

Normal daily activity must be understood to evaluate bed counts. When a band arrives on an area and begins to feed, a few individuals drift off by themselves, while most of the sheep remain in one group. At intervals during the day the entire band beds down wherever it may be. The beds found on these areas will be grouped together, for the most part, within a radius of twenty yards, the location of the groups depending upon the movement between rest periods. While the band is bedded, some sheep rise to feed for a few moments or to defecate or stretch. They may lie down again in the same beds or they may paw out new ones. The forming of two beds at one resting area by some sheep was assumed to compensate roughly for those bedded apart from the main group. Accordingly the number of fresh beds in one of these groups was taken as a rough indication of the total number of sheep in the band. This system was found applicable only on alpine plateaus where such sign is readily seen. Inasmuch as level plateaus are few in number, it was possible to census only a small portion of each herd range by this method. Elsewhere estimates of numbers had to be based on general evaluation of sign and on the extent of favorable bighorn habitat. These factors were correlated with the numbers of sheep that I observed and also with the numbers reported by other people.

TABLE 1

ESTIMATED NUMBERS OF BIGHORNS IN VARIOUS HERD RANGES, AND SYNOPSIS OF DATA ON WHICH ESTIMATES WERE BASED

Herd	Sheep seen by FLJ, 1948	Sheep seen by others	Beds censused by FLJ, 1948	Area of range[a]	Density[b]	Estimated number
Convict Creek	.....	1935—12 1936—2 1937—6+ 1943—2 1947—2 1948—15	.....	35	.7	25
Birch Mountain	6 (tracks)	1940—1	.....	20	.75	15
Baxter Taboose Pass to Sawmill	.....	1937—3 1938—1-2 1939—2 1940+[c] 1946—2 1948—1	.....	35	.4	15
Sawmill Pass to Baxter	17	1936—5 1937—36+ 1938—79 1940—2 1941—2 1942—5 1945—19 1946—34 1947—1 1948—21	106	20	3.25	65
Baxter Pass to Kearsarge	5	1940—49 1941—39 1942—3 1943—36 1946—11 1947—1 1948—14	82	20	2.75	55
Williamson Kearsarge Pass to Junction	.....	1938—1 1940—6+ 1944—3 1948—2	56	20	1.75	35
Junction Pass to George Creek	19	1936—8 1938—5 1939—5 1940—23+ 1941—12+ 1942—9 1946—4	10	30	2.0	60

TABLE 1 *(Continued)*

Herd	Sheep seen by FLJ, 1948	Sheep seen by others	Beds censused by FLJ, 1948	Area of range[a]	Density[b]	Estimated number
George Creek to Mount Russell	6	1936—3 1937—1 1939—4 1940—5 1946—2 1947—11+	8	15	2.0	30
Langley						
Mount Langley to Cirque Peak	7	1946—6 1947—12 1948—2+ 1949—1	14	25	1.0	25
Cirque Peak to Olancha Peak	.....	1938—1 1942—1 1946—15 1948—2	.....	95	.5	50
Olancha Peak to Glennville	.....	1936—1 1942—2 1944—1 1947—1	.....	35	.4	15
Totals	54		276	350	1.1	390

[a] In square miles. [b] In sheep per square mile. [c] "Up to 1940, several."

Estimates.—The best data on numbers were obtained for the Baxter and Williamson herds. These were the populations of greatest density, and their numbers were estimated by first summarizing all available records (table 1) and then eliminating possible duplications to arrive at a minimum total for each local band. Though rams and ewes presumably occur in equal numbers they were not seen proportionately (table 4). Numbers were adjusted to include those sheep not tabulated but assumed to be present (i.e., 5 ewes seen represents 5 rams not seen to make a total of 10). Additions to this minimum were made on the basis of sign (tracks, beds) where no sheep were seen. A density figure was thereby derived which was applied to the total area known to be occupied, with due allowance made for quality of habitat as well as amount.

The estimate for the Convict Creek herd is based solely on second-hand information; that for the Langley herd is based mainly on second-hand information, but is supplemented by my own observations; while those for the Birch Mountain, Baxter, and Williamson herds are derived for the most part from my own observations.

The individual herds are discussed below.

Convict Creek herd.—The northernmost, the Convict Creek herd, ranges on the headquarters of Convict and McGee creeks. Reports of sheep there have been few and I did not have time to cover the area. The animals are evidently isolated from the other herds to the south by a 35-mile gap, though it is possible that individual sheep may span this. Evidence of wide wandering is suggested by a report in 1947 of two rams seen by cattlemen 10 miles to the west on "Pincushion Peak."

The latest account of sheep in this herd is given by Dick Reese, Los Angeles attorney, who reports that he saw a band of 15 at upper Hilton Lake in August, 1948. This information coupled with reports of past years (table 1) points to a small but fairly stable population.

Birch Mountain herd.—This herd is found twenty miles to the south of the Convict Creek range. My best evidence of the presence of sheep around Birch Mountain was personal observation of tracks made by a band of six ewes and lambs at an elevation of 13,200 feet on the east side of The Thumb. In former years Norman Clyde has seen bighorn in this area and he also has found their sign. There is an outside possibility that these observations are of animals that have wandered north from Taboose Pass. However, it is my belief that a separate herd resides here. The paucity of evidence indicates a small population.

There are no records of occurrence between Tinemaha Creek and Taboose Pass, four miles to the south. The area occupied seems to be between the South Fork of Big Pine Creek and Tinemaha Creek.

Mount Baxter herd.—This is the largest and best known herd in the Sierra Nevada. The sheep are concentrated mainly between Sawmill Creek and the South Fork of Oak Creek. Bands are most commonly seen at the head of Thibaut Creek and along the trail going over Baxter Pass at the head of the North Fork of Oak Creek. These localities are the most frequented by humans in the range of this herd, the former being favored by local deer hunters and the latter being used extensively by pack parties entering Kings Canyon National Park.

I observed bands of sheep on Baxter, on the ridge from there to Peak 12,411 and on Diamond Peak (see table 4). I found abundant sign at all these localities as well as on the crest north and south of Baxter, on the ridges running northwest to Peak 12,329 and northeast to Peak 12,411, and in the basins to northwest and southeast. There was abundant sign at the heads of Thibaut Creek. The Baxter Pass area, on the crest midway between Peak 12,206 and Peak 13,051, was heavily trailed. Sign was heavy from there northeast toward Peak 10,643. There was

sign on the crest between Diamond and Black Mountain, and the ridge from Black Mountain northeast to Peak 12,617 was heavily used. Bighorn had been on the crest south of Black Mountain and on the ridge east to Peak 12,710. The plateau northwest of Gould was heavily tracked.

To the north, between Baxter and Taboose Pass, fewer sheep occur. For the most part the slopes there are of gentler nature and are used more by deer in crossing the crest than by sheep. The only sign I found along the crest in this entire section was probable tracks of a few sheep on Goodale Mountain, on the ridge east to Peak 11,764 and on the crest one-half mile north of Colosseum Mountain.

At times bighorn are seen well west of the crest here. One account is given by George Parker, packer on the South Fork of Oak Creek, who reported seeing a band of fourteen on the John Muir Trail one mile west of its junction with the Sawmill Pass Trail in the summer of 1944 or 1945. The sheep were coming from the country around the White Fork of Woods Creek and were headed for the ridge that runs south and east of Peak 11,243. I saw considerable sign along this ridge, from Peak 12,329 to Baxter, showing that bighorn regularly range on it. Nelson Murdock, Kings Canyon Park ranger, told of unconfirmed reports of sheep having been seen in the country around Mounts Clarence King and Gardiner by mountain climbers in the summer of 1947.

The wide canyon of Independence Creek and the continuous human use of the trail from the pack stations at Onion Valley over the crest at Kearsarge Pass seem to limit movement of sheep to the south. With the exception of wandering rams, the sheep of the Baxter herd range no farther in this direction than Mount Gould, which is just north of Kearsarge Pass.

Mount Williamson herd.—This is the second largest herd. It ranges between Pinyon Creek and Mount Russell. I found sheep to be relatively common throughout this entire region except at the extreme northerly and southerly limits. Single wandering rams are seen on occasion between Pinyon and Gould, and between Russell and Langley, the northern limit of the next herd to the south.

The northernmost evidence of bighorn that I found was just north of Peak 12,910. The plateau north of Mount Bradley was heavily used and sign extended down through the chutes and ridges on the west side of the crest. There was sign out on the ridge east of Bradley toward Peak 11,251, on the southeast face of Bradley and along the crest south to Junction Pass. The slopes at the heads of Symmes Creek evidenced continual use. There was sign all about Mount Keith and Junction Pass.

The area about Williamson, including Williamson Creek, Bairs Creek, and George Creek drainages, is especially favored by the sheep. Much broken and extremely rugged terrain occurs in this area. Each of the three times that I was in the country at the head of George Creek I saw sheep.

I found sign on Tunnabora Peak, on the plateau to northeast, and south along the crest to Mount Carillon. There were a few beds high on the south side of Russell.

A few unconfirmed accounts indicate that wandering rams occur on occasion on the Kings-Kern Divide.

At the southern end of this range Lone Pine Creek forms a partial barrier similar to that formed by Independence Creek. South of there, again, only individual sheep are seen.

Mount Langley herd.—The range of this herd, the most southerly population of Sierra bighorn, lies between Langley, or Tuttle Creek, and Monache Meadows. Sheep range mainly on the eastern slopes, but they also are regularly found on rocky outcrops throughout the low country west of the crest. At times they wander many miles to the southwest and appear low on the western slope of the Sierra Nevada, as at Glennville. Owing to the less rugged nature of the country to the south of Langley, the population of sheep is sparser there than to the north.

Between Langley and Russell there is a large gap in the Sierra sheep population, in which individuals are seen only occasionally. In September of 1948 Clyde saw what he believed to be sheep tracks and droppings on the southeast slope of Irvine. He had no time to examine the sign closely and so could make only a passing observation. There are a few accounts in past years of sheep or sign having been encountered at the heads of Rock Creek and the South and Middle Forks of Lone Pine Creek, and about Mount Hitchcock, but these indicate wandering bands or individuals rather than residents. In my field work I found no sheep sign whatever between Russell and Langley. A possible reason for this hiatus in the range is the sparseness of the vegetation in the area. The alpine plateaus along this section of the crest support very little vegetation in comparison with similar areas to the north and south.

Sign was abundant all around Langley, but particularly on the south and southeast slopes. I observed a band on the plateau at the southeast base of the mountain (table 4). There was sign down to Army Pass and along the ridge to the southeast toward Peak 12,819.

Monache Meadows are evidently the southernmost limit of the regular range of the Langley herd.

Population trend.—On the basis of these observations I estimate the total population to be 390 sheep. In past years there have been several other estimates of numbers made. In 1931 Ed Ober, State Game Warden in Independence for many years, estimated that there were 200 Sierra sheep. The 1940 Fish and Game Report of the Inyo National Forest estimated 140. The data on bighorn were acquired incidentally during a deer census. In an article published in the San Francisco *News* in 1941, the U. S. Fish and Wildlife Service estimated 360. In a letter written to R. T. Orr in 1944, Norman Clyde estimated 75–100 for that year. These figures all resulted from random or incomplete observations. For this reason, and since they are at such variance, they cannot be used for direct comparison. Nonetheless, the fact that my figure is appreciably higher than most of the others would suggest a possible upturn in the population trend. This supposition is strengthened by data on survival to be presented below. Tentatively I am of the opinion that the low point has been passed and that with proper protection and management the Sierra bighorn can be restored, if not to former numbers, at least to a safe and permanent population.

Other sheep in the Sierra Nevada.—From Olancha Creek to the southern end of the Sierra Nevada at Tehachapi, Kern County, bighorn are seen from time to time in various widely separated places along the eastern slope—probably being Nelson sheep that have wandered west from the desert ranges. The possibility of a remnant herd's now being in the Piute Ridge area of Tuolumne County has already been discussed.

Terrain

The nature of the terrain in the ranges of the four most northerly herds is very similar, consisting of the rugged alpine peaks ranging between elevations of 12,000 and 14,495 feet which form the crest of the Sierra Nevada and of the precipitous and broken, arid, eastern slope that descends 7,000–10,000 feet to Owens Valley (figures 4 and 5).

The portion of the crest along which the Langley herd ranges is of gentler topography (figure 5). Here only a few peaks reach above timberline, which is at about 11,400 feet. These are grouped in the northern part of the range. Olancha Peak is 12,135 feet and stands by itself many miles south of any other alpine peaks. Immediately south of it the mountains drop to elevations of 8,000 to 10,000 feet, well below timberline. The country to the west of the crest here is made up of large meadows and timbered country, only scattered portions of it being suitable for sheep.

Climate

The climate of the eastern slope is much more arid than that of the western. The average annual precipitation at South Lake, Inyo County, at 9,700 feet on the eastern slope, was 18.15 inches for the period between 1927 and 1941, according to data in the 1941 Yearbook of Agriculture. Independence, at an elevation of 4,000 feet in Owens Valley, received an average of 4.49 inches per year between 1901 and 1941. By comparison, Huntington Lake, Fresno County, on the western slope nearly due west of South Lake at an elevation of 7,000 feet, received a yearly average of 29.32 inches between 1918 and 1941. When these figures are compared, the effect of the intervening high country on precipitation can readily be seen.

Most of the annual precipitation comes as snow between November and March. Usually this has melted from the peaks by the middle of July.

Vegetation

The lower eastern slope of the Sierra Nevada, which begins at about 6,000 feet, is characterized by an arid type of vegetation. Rabbit brush (*Chrysothamnus* sp.), sage (*Artemisia* sp.), deer brush (*Ceanothus* sp.), manzanita (*Arctostaphylos* sp.), chinquapin (*Castanopsis sempervirens*) and pinyon pine (*Pinus cembroides* var. *monophylla*) are typical of the ridges. In the bottoms of the steep canyons species of a more mesophytic nature, such as fir (*Abies* sp.), oak (*Quercus* sp.) and willow (*Salix* sp.), occur. At higher altitudes open stands of foxtail pine (*Pinus balfouriana*) and Jeffrey pine (*Pinus ponderosa* var. *jeffreyi*) are found where they can form among the granite rocks. Above 11,400 feet, which is about the elevation of timberline, there are many species of small alpine forbs and grasses. These will be discussed in greater detail in the section on food habits.

Seasonal Ranges

In the spring, summer, and fall sheep are found anywhere on the east slope and crest, the concentration being on the higher areas (figure 7).

The first heavy snowstorms, which usually come late in November or December, force most of the sheep to the lower slopes of the east side. Sheep that have been wandering west of the crest either return to the eastern slopes by this time or run the danger of being trapped in the western slope's deep snows, the primary factor limiting the occurrence of bighorn there.

Between storms, when the snow has blown from the ridges and alpine plateaus and has melted to some degree from the southern exposures

(figure 6) many of the sheep return temporarily to the higher altitudes. When another storm hits they descend to the lower slopes again. It is believed that a certain number of bighorns remain on high windswept areas all winter long. During winters of heavy snow, sheep are commonly found on the slopes just above the piedmont plain of Owens Valley. Such periods as these, when the greater number of the sheep are concentrated in a narrow belt at the foot of the mountains, were found by E. L. Shellenbarger, former ranger on the Inyo National Forest, to be the most favorable for census purposes. In the spring the concentration shifts and spreads itself over a greater area as the higher slopes become uncovered.

LIFE HISTORY

Physical Characteristics

Coloration.—Three or four distinct color patterns and several less distinct ones may be represented in large bands. These patterns vary from a solid shade over the entire body to different combinations of dark and light on such regions as the shoulders, legs, dorsal line, and underparts.

Rams after the second or third year are uniformly dark. No adult rams of a light shade were seen. Ewes and young rams are generally paler but some individuals are of as dark a brown as the adult rams. According to Parker, young lambs are white. Older lambs that I observed were lighter than the ewes and probably remain so until grown. Most individuals, including newborn lambs, have light rump patches and muzzles which contrast with the general body color.

Some individuals have a dark dorsal stripe which bisects the rump patch. The tail is centered in the rump patch as a dark dot on those lacking the stripe.

Horns.—It was noted on November 7 that the lambs of the year, then about six months old, showed black stubs of horns. Sex could not be determined by the horns in this age group nor in that of the yearlings. On animals older than two years the distinctive sexual bimorphism of the horns is evident. Horn development in bighorn sheep is discussed at length by Cowan (1940).

Horn tips of some bighorn rams are broken off or broomed, but in the Sierra rams they are mostly entire. Ober (1931) believes that the Nelson rams break their horn tips by digging among the rocks for roots, though he gives no information in support of the statement. I found no evidence that Sierra rams ever use their horns in digging. Other suggested explanations for brooming—combat, deliberate chipping because of interference

with vision, and accidental wear-off (Seton, 1929; Cowan, 1940)—do not explain the lack of it in the Sierra rams.

The horn tips are used by both sexes in scratching, as also are the hind feet.

Hooves.—The hooves of mountain sheep are especially adapted for a rocky habitat. The posterior half of each toe is formed into a rounded, rubbery pad that readily grips rock. The toes are independently movable so that the hoof conforms equally well to flat or sloping surfaces. On steep, sandy mountainsides tracks with the two halves separated an inch or more are often seen. The forefeet of sheep are larger than the hindfeet and leave correspondingly larger tracks (see figure 8).

TABLE 2

MEASUREMENTS (IN MM.) AND WEIGHTS OF SIERRA BIGHORN KILLED NEAR MOUNT BAXTER IN 1911

Sex	Age	Total length	Tail	Hind foot	Ear	Weight (pounds)
Male	5	1570	100	420	110	200
Male	3	1582	110	420	120	200
Male	2	1445	70	400	120	150
Female	3	1385	70	395	106	150

Size.—Adult rams are much larger in all dimensions than adult ewes or young rams. By comparison, a two-year-old ram appears to an adult ram as a six-month-old lamb appears to an adult ewe.

Measurements and weights of four sheep collected near Baxter in 1911 by Carr for the Museum of Vertebrate Zoölogy are given in table 2.

The maximum weight attained is not known. Canadian rams are known to exceed 300 pounds (Seton, 1929) but it is not known that Sierra rams ever become so large.

SENSES

Vision.—The acuteness of the vision of bighorns is indicated by the following experience. A band that I startled near Baxter traveled rapidly to a ridge of black rock one air-line mile away. As they appeared light against the dark background it was possible to pick them out with the naked eye as small dots, when I knew exactly where they were. Through the eight-power binocular it was evident that several still were interested in me as they could be seen to stand and stare in my direction for several seconds at a time. There was no doubt that they could see me against rock of a shade similar to that of my clothing. Whenever I moved several

individuals would raise their heads and look toward me. Considering the readiness of their response I believed that their unaided vision was nearly equal to mine with the aid of the binocular.

Vision appears to be the sense most relied upon for safety, as the stimulus of a moving object was found most often to precipitate flight.

Hearing.—There was little opportunity to make any absolute determination of hearing ability. On one occasion several sheep, bedded 100 yards away across a running brook, responded to the snapping of twigs by suddenly jumping up. Fluctuating air currents in mountainous regions cause sounds to be carried in an uncertain manner. Often a band of sheep can be closely approached with considerable noise when their vision is blocked, apparently because the sounds made do not reach them. Near-by disturbances, such as rock slides, will attract the attention of sheep and may stimulate flight. Distant slides, however, do not attract noticeable attention. Repetitive noises, as caused by a person traversing a talus slope, will cause suspicion, however, and sometimes even flight. On one occasion a four-engined airplane flew high over a feeding band; a few sheep that were feeding looked up momentarily but none of those bedded paid any attention to it.

Smell.—My scent, carried to a band 100 yards away, aroused uneasiness but was not enough in itself to cause any great alarm. At the same distance the sight of a moving object would have put the sheep to flight. It does not appear that scent is relied upon to any great extent. During the rutting season, the scent emitted by the ewes in heat stimulates the rams to mating fervor.

Sign

Mule deer occur over most of the mountain-sheep range in the Sierra Nevada with the exception of the extreme alpine regions. The highest elevation at which I encountered deer sign was at 12,200 feet, or 1,000 feet above timberline. (Jules Eichorn reports 13,000 feet on Thunder Mountain in July, 1948.) They travel somewhat higher than this when crossing the crest in certain places. In view of the coexistence of the two animals an analysis of sign of each will be made.

Tracks.—Figures 8–10 show typical bighorn tracks in mud and snow. In general sheep tracks are larger in width and length than deer tracks. The two halves are separated anteriorly and the track appears blunt and squared off rather than pointed as in most deer. There is a marked cone in the center of the track corresponding to the interior curves of each half. On favorable soil the rubbery pad on the posterior portion of each half leaves a definite rounded depression not found in deer tracks. The

posterior end of the track appears squared off, with less of an indentation between the ends of the two halves. Identification is difficult when large deer leave split but indistinct tracks on sandy areas. Such tracks usually may be identified by considering differences between normal strides of deer and sheep. Sheep, having shorter legs, have shorter strides. Furthermore they have larger hooves in comparison to leg length than do deer. Table 3 shows average distances between tracks of sheep and deer resulting from measurement of a series of tracks of five adult deer and of 27 adult sheep. The arithmetic means and medians are identical when computed to the nearest inch; the values are given merely as averages.

A track interval–track length ratio resulting from measurements of tracks of four adult deer and four adult sheep is: sheep, 6:1; deer, 9.5:1.

TABLE 3
AVERAGE DISTANCE BETWEEN TRACKS OF SHEEP AND DEER

	Sheep	Deer
Sets of tracks	27	5
Range of intervals between tracks	12–19″	18–24″
Average interval	16″	21″

A track-interval to track-length ratio resulting from measurements of tracks of four adult deer and of four adult sheep is as follows: sheep, 6:1; deer, 9.5:1.

Trails.—Certain routes used extensively by bighorn, such as those leading to watering spots and to salt licks, become heavily trailed, the trails being well defined and visible for long distances. Trails develop readily in sand but are also found across slopes of small talus. A series of trails one foot wide was noted across such a slope near Baxter Pass, at the head of the North Fork of Oak Creek. The larger rocks had been tumbled to the side with time so that pathways of small stones remained. These had been shifted and rolled so that a fairly flat surface resulted.

Horse trails are readily utilized by sheep where they are available. Along some, such as the one over Baxter Pass, sheep or their fresh sign are commonly encountered.

Sheep trails run through rocky areas more commonly than do those of deer, but where the two species occur together they use each other's trails.

Droppings.—In areas where deer and bighorn occur together I know of no method by which their droppings can consistently be told apart. On the average, sheep pellets have a tailed, chocolate-drop form, while those of deer appear longer, more tubular and tend to be rounded on both ends. However, there is considerable variation and overlapping in the pellets

of sheep and deer, and appearance alone is unreliable in identification. Fresh droppings of both are similar in color, being dark brown to black.

Sheep droppings are generally deposited singly but they may be dropped in tight clusters depending upon the forage and the condition of the animal. When deposited in a cluster, each pellet is flattened and contains much more material than one voided singly. Lamb droppings over the first summer are considerably smaller than are those of adults. Piles of these at bed areas give an indication of the number of lambs in the band when an estimate of numbers by groups of beds is made.

Sheep droppings characteristically have hard, external envelopes. When the pellets are freshly voided this envelope is moist, but it soon dries to a hard, claylike consistency. The interiors of the droppings are not noticeably moist even when fresh, and the urine is thick and concentrated, both of which indicate moisture conservation by the body.

Beds.—Sheep beds are oval depressions, about two feet long by one and one-half feet wide, pawed out by the animals for resting or sleeping purposes (see figure 10). Loose surface rock is cleared from the spot and a hollow is made by several swipes of a forefoot. On sandy ground sheep may lie anywhere without bothering to make a bed.

Beds vary in depth from a few inches to well over a foot, depending upon the nature of the surface material and upon the number of times that each has been used. Generally a bed is pawed out each time a sheep lies down, but often an old bed from some years past is used. Old beds are often pawed deeper before being used again, sometimes attaining a depth of eighteen inches or more.

When lying down after a brief rise, a sheep may make a new bed a few feet away from the old one or it may resettle in the same one. The number of piles of fresh droppings at a bed is an indication of the length of time that it has been used by an animal. Though sheep void several times a day no absolute figure is available.

During the day, beds are made at random wherever the sheep may be feeding. They are always made in the open, though not necessarily at a place affording a view of the surrounding country. At night a spot among, or near, rugged chuted cliffs is chosen for the bedding area. The same region may be used on several successive nights, though not necessarily the same beds.

Where deer and sheep occur together and other sign is lacking, the identity of a bed can often be told by its location. Deer generally bed under trees or in brushy areas that afford seclusion while sheep generally bed on open slopes.

Feeding sign.—On areas of loose soil, sheep paw up many of the plants that they feed on, leaving conspicuous pits. Fragments of roots and foliar parts are often left in the pits or around their edges. Such sign is characteristic of sheep and is readily attributable to them. Marmots often leave similar sign, but this is identifiable by the presence of scratch marks.

Bands

Composition.—During the greater part of the year, most rams two years old or more run independently of the ewes, yearlings, and lambs. They may roam alone or in bands up to ten or more. The largest ram band that I have heard of was one of 12 seen on October 3, 1948, on Sawmill Pass by Dick Squires, of Independence. Though not certain that all 12 were rams, he stated that most of them were and that no lambs were present. On September 29, 1948, I observed a band of seven rams on the south side of Langley. Of these one was no older than three years, one was about five, two were between five and seven and three were seven or over. Rams are most frequently seen singly or in groups of two or three, however.

During the year, rams frequently encounter ewe bands and often run with them for short periods. In the late fall the rams join the ewes for the rutting season. When this is completed they band up separately again.

Bands of ewes, yearlings and lambs commonly vary in number from 5 to 15. Bands larger than 15 frequently are seen, especially during the winter. A few rams are nearly always present in these. I have found no substantiated accounts of bands larger than 34 individuals. Griggs reports having seen one of this size southeast of Black Mountain in the summer of 1940, and H. V. Hague, Hunter and Trapper, California Division of Fish and Game at Bishop, reports having seen one of about this size at the mouth of Sawmill Creek Canyon in the winter of either 1945 or 1946.

Yearling rams leave the ewes during their second year and join the older rams. I observed their behavior preliminary to this departure at the head of George Creek on September 6 and 7. Increased interest was taken in adult rams by a yearling which was a member of a ewe band of 14. On the first day the yearling joined two rams, estimated to be two and three years old, which appeared near by. Late in the afternoon, when the ewes were moving toward a night bedding place, the yearling rejoined them. On the following morning, he immediately went to one of the two rams and fed in his company during the rest of the day. Though both rams remained with the ewes during this entire day, it appeared evident

from the actions of the yearling that he was approaching the time when he would depart from the ewe band.

Sex and age ratios.—Data accumulated on sex and age compositions of bands observed during the field work are given in table 4.

TABLE 4

INDIVIDUAL SHEEP OBSERVED IN 1948

Date	Locality	Rams	Old ewes	Breeding ewes	Yearlings	Lambs	Unknown	Total
July 22	Mount Baxter		1	6	5	5		17
Aug. 20	Diamond Peak						5	5
Sept. 29	Mount Langley	7						7
Nov. 6	George Creek		2	2		2		6
Nov. 7	George Creek	3	2	6	4	4		19
	Total	10	5	14	9	11	5	54
	Approximate Percentages	20	40		18	22	....	100

There were 103 sheep actually seen; elimination of all possible chances of duplication, however, reduces the total to 54. The number of adult rams seen in comparison with adult ewes does not necessarily reflect the true sex ratio in the Sierra sheep population. Spencer (1943) and Pulling (1945) found the sex ratio in Rocky Mountain and Nelson sheep, respectively, to be 100:100. There is no reason to believe that the situation with the Sierra sheep is any different. A possible explanation for the unbalanced ratio in my observations is that the rams run alone, or in small bands as compared to the ewes, and therefore are more easily missed by an observer concentrating in areas where sign is most abundant.

The data in table 4 give a lamb–ewe ratio of 50:100. This includes all ewes—old, breeding, and half of the yearlings.

Bighorn ewes are believed to breed at the age of two years by some writers (Seton, 1929; Frakes, 1907) and at three years by others (Spencer, 1943; Allen, 1939). Very old ewes probably do not bear lambs (Mills, 1937; Davis, 1938). If the old and yearling ewes are left out and the rest taken as breeding ewes, a lamb-breeding ewe ratio of 80:100 results. Considering that lambs are normally born singly, since no twins were seen, this ratio indicates that 80 per cent of possible reproduction was realized in 1948. Survival of lambs over the first winter is indicated by the yearling-lamb ratio of 80:100. Since breeding conditions over the last several years probably have been favorable, it is assumed that the lamb crop of 1947 was roughly equal to that of 1948. This ratio indicates

that of 100 lambs, 80 lived through the first winter—certainly an adequate rate of survival. Considering other populations of bighorn similarly analyzed (Mills, 1937; Davis, 1938; Murie, 1940; Cowan, 1945, 1946) these figures point to a probable increase in numbers of the Sierra sheep in 1948. Whether this was merely the result of an especially favorable year or whether it reflects a real upward trend in the population, as suggested above, cannot be determined with the data at hand.

Specificity of bands.—Observation of bands on Baxter and at the head of George Creek on successive days indicates that shifts in numbers and individuals of a band occur from day to day. On July 22 on Baxter I saw a band of 17 sheep—7 ewes, 5 yearlings, and 5 lambs. On the 23d there were only 11—5 ewes, 4 lambs, and 2 undetermined. On the 24th, the number was still 11. The larger band may have consisted of two smaller bands which fed together for a short time, or a small band may have split off.

The band of 7 ewes, 2 yearlings, and 5 lambs seen on the morning of September 6 at the head of George Creek was joined during the day by 2 young rams. In the evening, just before nightfall, one of the rams went off alone and the band separated with considerable shifting and changing of minds into groups of 7 and 8. Next morning a group of 7 was found on the same plateau. By noon, 9 more arrived, including a ram. By mid-afternoon, there were 17—1 ram, 8 ewes, 2 yearlings, and 6 lambs;—and by nightfall there were 20, 3 unidentified sheep having appeared. In the same area on November 7 a band of 18—2 rams, 8 ewes, 4 yearlings, and 4 lambs—was seen. During the day a third ram joined the band. On the preceding day a single ewe and a band of 3 ewes and 2 lambs had been seen only a few miles away.

It is obvious from these scattered observations that continual interchange of individuals is normal between bands and that therefore a band cannot be considered to be a fixed unit. It is believed that ewes change their home range little though they shift between bands. Rams are prone to wander, however, and are often found many miles outside the limits of the herd ranges. They span the gaps that separate the herds with regularity, except perhaps the gap between the Convict Creek and the Birch Mountain herds.

Leadership.—Ewe bands are generally led by an old, lambless ewe. When on a feeding area, she often feeds and beds away from the rest of the sheep and spends much more time looking about than do the others. When she decides to move any distance the rest of the band generally follows along. When traveling, most of the members form a close-knit

group, often in file formation, so that the exact route taken by the lead ewe is followed by them. The lead ewe feeds along as do the others and though she is followed by them there is no visible sign of command. There are always two or three individuals that travel independently, choosing their own routes. While for the longer moves it can be determined that one ewe is the leader, for the shorter moves often the first sheep to move or to deviate is the one that is followed.

LAMBS

Development.—Allen (1939) found the gestation period of bighorn sheep to be about 180 days. As the Sierra sheep were observed to begin the rut in November, parturition for them is placed in the months of May and June. No twins were seen.

Lambs were first observed on July 22, at which time they were about 2 months old and quite small. At an age of about 3½ months they were approximately one-half the size of their mothers. At 5½ months they had small horns 2–3 inches long but were still noticeably smaller than the yearlings. It is apparent that growth through the first summer is rapid.

Nursing.—The lambs observed on July 22, at an age of about 2 months, fed on vegetation in the same manner and as avidly as did the adults. During a period of 4 hours the 5 lambs present in this band were seen to nurse a total of four times. Two of these nursings were for a period of only a few seconds, while the other two were for somewhat longer periods. On September 6 and 7, at an age of about 3½ months, the lambs had practically ceased nursing. Of the 5 and 6 lambs kept under observation during these respective days, only two attempts to nurse were observed. One of the lambs was permitted by the ewe to nurse for a few seconds; the other was rebuffed. Lambs were not seen again until November 6, when they were about 5½ months old. Two observed on this date for 2½ hours and 4 observed on November 7 for 7 hours were not seen to attempt to nurse.

When nursing or attempting to nurse, the lambs behave vigorously. Some ran and dived at the udder from several feet away. Some nursed quietly while others butted the udder, with tails waggling furiously. Such treatment does not bother the ewes. Feedings were of short duration and were usually ended by the ewe, who would step over the lamb's head with one hind-leg and walk off.

Play.—At all ages lambs were frisky. They played with their mothers, among themselves, or alone. As one form of group play, several lambs stood with their heads together, pushing at each other. This was kept up

for periods of 10–15 minutes at a time. When the band is traveling, the lambs dash and jump about a great deal. One was seen to jump from one large rock to another, then to make a high spring to the ground; it then ran a few steps, leaped into the air in an upright position waving its forelegs, turned half around, lit and sprang to another rock. A rock rolled underfoot will often give a lamb an excuse to dash wildly across the slope.

Play involving the mothers is the most common type. One lamb ran close alongside its mother from behind her and suddenly dashed under her neck. She tossed her head as the lamb continued on around to her opposite side, still leaning into her. She then rapidly sidestepped a few feet and left it unsupported. A few minutes later she sat on the lamb so that it was forced to crawl out between her hind legs. Though many mothers engage in play with their lambs, others do not seem to respond.

There is also play between adults, though it is not so common as among lambs. Such activity was noticed most often in the early evening, when temperatures decreased and the sheep moved from the daytime feeding area to the nighttime bedding area. One ewe, leading a band down a slope at a dead run, leaped off a rock and, spinning on her hind-feet, sent up a cloud of sand as she hit the sandy gravel. She then stood stockstill, as did the others. After this brief pause the entire band dashed down the slope, sliding, and jumping in the sand.

On several occasions during the daytime, two to three ewes stood head to head and pushed at each other for several minutes at a time. Often a feeding animal butted at one which was down, causing it to jump up and be engaged in a bout of pushing. Two sheep often stand head to tail and nuzzle each other for several minutes at a time.

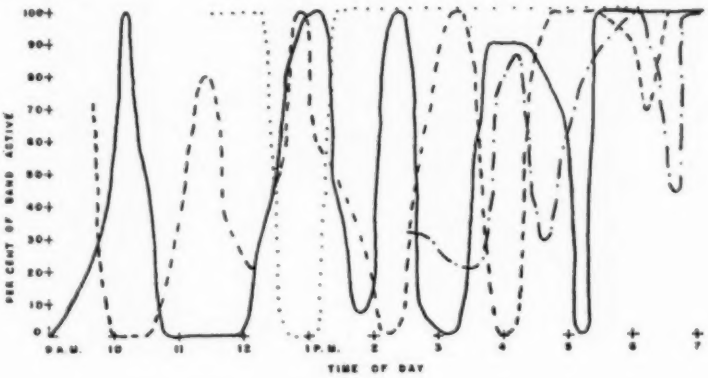
Behavior

Feeding.—In summer somewhat more than half of the daylight hours are spent in feeding (table 5). For most of the day, periods when half or more of the band is feeding average about one hour in duration. The band as a whole moves only short distances between bedding periods, though individual sheep are constantly moving when feeding. Distances moved by a George Creek band during feeding periods on two successive days ranged from 35 to 200 yards, averaging 150.

As they feed, sheep wander around or over rocks, moving about considerably. Often one will be attracted by a plant five to ten feet away and will walk rapidly over to take it. When on a favorable patch of vegetation, feeding may be quite deliberate, the animal standing in one spot for several minutes with head down, cropping everything within reach.

The areas grazed over during the day are usually open gravelly slopes that support a uniform, though sparse, plant cover. Feeding is continual when the animals are moving, unless in flight. Forage plants are found between large boulders, on talus slopes, in cracks on rock benches, on jagged ridges, wherever there is a spot of soil.

When feeding on sandy areas, pawing of vegetation is almost continuous. As soon as an animal paws up and eats one plant it walks a few



feet and paws up another. Pawing is done with either forefoot and several strokes are taken on each plant. Often when a plant is dug up only the roots are eaten. On grassy meadows pawing is not practiced, only the foliar parts of the plants being cropped as the animal moves along.

Bedding.—After feeding, sheep bed down to chew their cuds and rest. When lying down they characteristically lower their foreparts first, then their hindparts. Some do this slowly, making two deliberate motions, while others do it rapidly in one. Rising is the reverse process.

The adults generally lie partly on one side with their legs folded back against their bodies and with their heads held erect. At any one time all but one or two of a band will have their heads erect. They continuously gaze about when bedded, and as they lie facing either way across the slope all directions except that up the slope to their backs are constantly under

surveillance. Adults seldom relax completely during the day. When they do it is generally in a curled up position with the head laid back against the body. Infrequently they will stretch out full length on their sides with their legs extended. Lambs often lie in this position for several minutes, adults seldom for more than a minute. At times a sheep will rest with the head laid straight out. Rams often use this position, turning their heads so as to rest one horn on the ground. On one occasion a number of sheep lay on the tops of large boulders.

TABLE 5

DURATION OF DAYTIME FEEDING AND BEDDING PERIODS
(In Minutes)

Locality and date	Observed feeding periods					Observed bedding periods					
	Sheep	No.	Min.	Max.	Ave.	% time	No.	Min.	Max.	Ave.	% time
George Cr., Sept. 6	14	4	30	100	50	50	4	20	120	60	50
George Cr., Sept. 7	7–16	3	30	65	45	53	4	40	85	65	47
Langley, Sept. 29	7	2	35	100	70	56	2	10	35	20	44
George Cr., Nov. 7	18	....	....	....	....	86	1	....	....	55	14
Averages		9	30	90	55		11	25	90	50	

After having risen from a bed, each individual stretches thoroughly by extending its legs and arching its back. Often it voids, then stands over the bed looking about deliberately. This stance may be held for several minutes before the animal moves off to feed or lies down again.

Above is seen the pattern of daily activity of some bands which were continuously observed. Periods of feeding and resting alternated rather regularly. These periods as measured by the behavior of fifty per cent of each band during the extent of each observation are analyzed in table 5.

The portions of the feeding-bedding cycles shown in the accompanying chart that were not observed in entirety are not included in the computations in table 5. All averages are rounded to the nearest five-minute interval.

Individual sheep bed and feed for shorter periods at a time than the band as a whole. Seven rams seen on Langley on September 29 bedded for an average of 19 minutes at a time and fed for an average of 16 minutes; respective averages for 50 per cent of the band were 20 minutes

and 1 hour and 10 minutes. The extremes for individuals were: bedding, 3–51 minutes; feeding, 1–50 minutes.

The lengths of the feeding and resting periods vary, of course, with the type of forage, time of day, season and weather. Increased activity was noticed in late afternoon when sheep were moving to nighttime bedding areas, and at the beginning of the rutting season. At times the sheep were still feeding when it became too dark to observe them further; at other times they ceased feeding and trotted or ran toward a near-by precipitous region at dusk. All feeding areas observed were open slopes or meadows. The movements in the evening were toward cliffs lined with many arêtes and chutes. It appeared that this type of area was regularly used for bedding at night, though no positive observations were made. I did not find when activity began in the morning nor whether there was activity during the night.

Reaction to humans.—When come upon suddenly, the bighorns' first reaction is to jump up from their beds and to stare at the cause of the disturbance. If they notice subsequent movement they will bolt; otherwise they continue their scrutiny. After a time the animals begin to mill about slowly and will gradually drift away, staring constantly. If an object such as a red bandanna is allowed to flutter in the wind the curiosity of the sheep will bring them closer, sometimes to within 50 feet. They advance slowly and with much pivoting about as their suspicion overcomes their curiosity. At any sudden movement they will dash off.

Sheep are excited less by a man on horseback than by one afoot and will generally stand some distance away studying passing horsemen.

When startled into flight sheep run for a cliff or another broken area that is suitable for escape. When they have put enough of such terrain between themselves and the source of fright they generally stop and look back. At times they will stop after having run 150 yards or so across a level area, the distance covered sufficing for a feeling of safety. Any further excitation, however, will cause them to run for escape terrain. If one member of a band becomes excited and bolts, the others will, too.

Near-by noises from an unseen source cause the sheep gradually to drift away, as will a strange scent.

Sheep do approach close to human habitations with no sign of fear, though such behavior is uncommon.

Bighorn with other animals.—Stub Libstrom, an old resident of Independence, and also Shellenbarger and Walters report having seen Sierra sheep running with deer herds. All accounts are of rams except for one or two yearlings of unidentified sex.

A Geodetic Survey employee reportedly saw a bighorn in company with cattle on the eastern slope of the Sierra Nevada in the summer of 1948.

Accounts of sheep in other areas running with elk (Seton, 1929), cattle, domestic sheep, and goats show that such occurrences are common. Gregariousness undoubtedly leads bighorn to associate with other animals having herd instincts.

Food, Water and Minerals

Food habits.—Data on food habits were gathered by running line transects on feeding areas, analyzing droppings, by direct observation, from a scant few literature accounts and from conversations with local residents. All plant species found to be utilized as forage are listed in table 9. The nomenclature was confirmed by Dr. Carl W. Sharsmith, of Stanford University.

Transects made were six feet wide and of lengths varying from 120–460 feet. On all feeding areas 10 transects were made except on area number 1, on which five were made. For the most part, transects were run across the slope at 50-foot intervals, though some had to be closer together or irregularly spaced. Each clump of plants of each species was tabulated as grazed or ungrazed. The sparseness of the alpine vegetation made possible accurate counts of all clumps. Areas transected were:

1) Top of Baxter, 13,100 feet.
2) West end of ridge to east of crest north of Dragon Peak, 12,500 feet.
3) Main crest north of Gould, 12,800 feet.
4) South side of Junction Pass, 13,100 feet.
5) Top of Williamson, 14,000 feet.
6) Basin northeast of Barnard, 13,000 feet.
7) Ridge southeast of Peak 13,968, 12,800 feet.
8) Plateau southeast of Langley, 13,400 feet.
9) Head of north fork of Symmes Creek, 9,500 feet.

These areas exhibited such heavy sign of having been fed on by sheep that the data gathered on them were not felt to be measurably affected by feeding activity of deer, marmots, rabbits, or conies. At low elevations, other than in area number 9, it was not possible to delimit bighorn feeding areas owing to the lack of sign left in the heavier stands of vegetation—bushes and trees with dense understories and much surface litter—and also to the higher proportion of feeding sign left by deer.

Transect areas 1–8 were at high altitudes and were characterized by alpine vegetation. Transect 9, however, was low on the east slope and

supported a subalpine vegetation characteristic of the eastern side of the Sierra. The data for the first eight areas are compiled in table 6 and for the last in table 7. In this manner of presentation forage preference com-

TABLE 6

PLANT SPECIES IN TRANSECTS 1–8 AND RELATIVE AMOUNT OF USE

Species	Composition	Individual plants grazed	Representation in sheep diet	Number of transects
Hulsea algida	34%	41%	47%	8
Polemonium eximium	20	41	21	5
Ivesia sp. (as *pygmaea*)	18	25	18	4
Grasses	9	18	6	7
Erigeron sp.	5	15	3	4
Eriogonum ovalifolium	10	6	3	5
Phlox dispersa	1	29	2	1
Ranunculus eschscholtzii var. *oxynotus*	T	75	T	1
Castilleia nana	T	0	0	1
Miscellaneous	3	1	T	4

T represents values less than .5 per cent. Total area transected, 58,194 square feet; per cent total plants grazed, 29; density of vegetation, 1 clump per 11.5 square feet. Plant coverage visually estimated at less than 1 per cent.

TABLE 7

PLANT SPECIES IN TRANSECT 9, AND RELATIVE AMOUNT OF USE

Species	Composition	Individual plants grazed	Representation in sheep diet
Carex congdonii	19%	65%	68%
Ivesia santolinoides	53	8	23
Monardella odoratissima subsp. *parvifolia*	13	12	9
Grasses	6	0	0
Eriogonum nudum var. *scapigerum*	4	0	0
Senecio fremontii	2	0	0
Holodiscus discolor	2	0	0
Eriogonum wrightii var. *subscaposum*	1	0	0
Artemisia tridentata	T	0	0

T represents values less than .5 per cent. Total area transected, 4,487 square feet; per cent total plants grazed, 19; density of vegetation, 1 clump per 8.5 square feet. Plant coverage visually estimated at less than 1 per cent.

parisons can be made between the two general zones. In these tables the "Composition" column was computed from the total number of clumps of all species found on all eight areas, though only one species occurred

on all eight. The "Individual plants grazed" column indicates the number of clumps of each species that were grazed in relation to the total number of clumps of it found. The "Representation in sheep diet" column shows the per cent formed by each species of the total number of clumps grazed.

Samples of piles of dropping were collected wherever encountered with the intention that they be analyzed for content. Each sample consisted of six pellets, or 12 of those of lambs. Samples were stored in Manila coin envelopes bearing locality data. To make possible identification of plant fragments, specimens of plants possibly utilized as forage by the sheep were collected. A total of 75 species representing most of the alpine food species was obtained. A small, light plant press of ample size for alpine collecting was made of a pulp magazine enclosed between two pieces of plywood and compressed by two large elastic bands. After drying, the specimens were stored in envelopes.

Quantitative evaluation of plant species in the droppings was found possible but impracticable. Identification of the finely ground fragments would have required a thorough study of the cellular structure of each part of each forage species, a process too involved for the scope of this study. A gross examination of readily identifiable material was the alternative, and of the 600 samples collected 60 were so analyzed. The hard, exterior coverings of all pellets of a sample were pared off and interior portions soaked in water in a corked shell vial for several hours. The material was then broken up and spread out in a petri dish and examined under a 12.5 power dissecting microscope. The material identifiable in the droppings and the frequency of occurrence of each item is listed in table 8.

Fragments of roots, and especially of leaves and stems were common but were usually unidentifiable. The plant species listed were identified solely by the presence of certain characteristic parts, such as complete flower buds, bracts, and leaves; therefore some were possibly more common than indicated. Many of the seeds were identifiable, most of them being sedges. The one invertebrate found, an insect, was undoubtedly picked up by accident. Small rocks are commonly ingested along with roots.

All plant species found to be used as forage are listed in table 9. The various alpine and subalpine species used as forage, as determined by the transect and pellet data, are given in Part I. These are listed in their order of importance as indicated by the two analyses and by observation of comparative degree of utilization of plants of each species. Several other species used as forage according to the literature, to conversations with

local people, and to direct observation, are listed in Part II. These are not in order of importance as the nature of the information does not make possible any such relative evaluation.

Certain plants, such as *Hulsea algida, Ivesia santolinoides,* and *Ivesia pygmaea* are pawed up and the roots taken. All three have a large tap root, that of *I. pygmaea* being soft and starchy. Often when the plant is

TABLE 8

FREQUENCY OF OCCURRENCE OF ITEMS FOUND IN 60 DROPPING SAMPLES

Item	Number of samples	Occurrence
Sedges	45	75%
Eriogonum sp.	20	33
Oxyria digyna	9	15
Grasses	4	7
Rushes	3	5
Draba lemmonii	2	3
Silene sargentii	1	2
Ranunculus eschscholtzii var. *oxynotus*	1	2
Rocks	47	
Seeds	43	
Root fragments	21	
Invertebrates	1	

pawed up the foliar parts are discarded, particularly with the *Ivesia* sp. The foliar parts of all three plants are commonly taken, however, particularly the flower heads. *Eriogonum* sp. and *Phlox dispersa* are commonly pawed up but the roots are not taken. The pawing seems to be done only to facilitate getting at the foliar parts, which are matlike. The other forage species (table 9) are rarely pawed up, the foliar parts only being taken. The flower heads of certain plants such as *Monardella odoratissima, Polemonium eximium, Carex* sp. and *Erigeron* sp. are favored over any other part.

H. algida is the most common alpine forage species; it occurs over the entire range of the sheep, and is heavily taken. On some areas all plants are grazed, and pawed pits 4–5 inches wide, 10–14 inches long and 3–4 inches deep are left where whole plants have been taken. Except for *Phlox dispersa,* which occurs only about Langley, and *Ivesia pygmaea,* which occurs only from about Black Mountain south, all of the alpine forage species are found throughout the range of the sheep. *Ranunculus eshscholtzii* is a highly palatable species for these bighorn but it is uncommon. It is found only in cool, damp spots, such as under overhanging

boulders, and is heavily utilized wherever found, being cropped as close to the ground as possible.

No evidence of feeding on brush species was encountered, though several species of *Ribes* occurred on heavily grazed alpine areas. At lower elevations, determination of utilization of brush species by bighorn was impossible owing to the abundance of deer. Sheep doubtless do take some browse on the winter range, and competition with domestic livestock and deer may be critical there.

TABLE 9

PLANT SPECIES USED AS FORAGE

I. Forage species in order of importance as determined from transects and from dropping analyses

1. *Hulsea algida*
2. *Carex congdonii* (and other *Carex* species)
3. *Polemonium eximium*
4. *Ivesia santolinoides*
5. *Ivesia pygmaea* (and other similar species of *Ivesia*)
6. Grass sp.
7. *Monardella odoratissima* subsp. *parvifolia*
8. *Erigeron* sp.
9. *Eriogonum ovalifolium* (and other *Eriogonum* species)
10. *Phlox dispersa*
11. *Ranunculus eschscholtzii* var. *oxynotus*
12. *Oxyria digyna*
13. *Draba lemmonii*
14. *Silene sargentii*

II. Additional forage species

Species	Source
Artemisia ludoviciana var. *incompta*	Observation
Artemisia dracunculoides	Carr's Field Notes
Artemisia heterophylla	Carr's Field Notes
Eriogonum nudum var. *scapigerum*	Observation
Eriogonum wrightii var. *subscaposum*	Observation
Lupinus lepidus	Observation
Penstemon (sp.?)	Conversation with Shellenbarger
Carex exserta	Note in Sierra Club file, 1940
Carex phaeocephala	Sharsmith (1938)
Carex breweri	Sharsmith (1938)

TABLE 9 *(continued)*

Lewisia pygmaea	Sharsmith (1938)
Delphinium pauciflorum	Sharsmith (1938)
Oreocarya confertifolia	Sharsmith (1938)
Penstemon menziesii var. *davidsonii*	Sharsmith (1938)
Antennaria dioica or *alpina*	Sharsmith (1938)

Water.—Springs forming the headwaters of the creeks of the eastern slope of the Sierra Nevada and pools collecting below melting snowbanks supply adequate water at high elevations during the summer months. Many of the springs dry up in the fall as the snow patches disappear. Water is always available at lower elevations, however, and early snows often occur on the alpine regions in October. During the winter when little free water is available it is probable that snow is eaten for moisture.

It is not certain how often these sheep water, but Seton (1929) states that Rocky Mountain bighorns drink once a day. No sheep were seen to drink, though all evidence indicates that they usually do so late in the evening or early in the morning. On one occasion sheep that had been feeding for the entire day several hundred feet above and half a mile away from a spring suddenly ran toward it in the late afternoon, apparently to drink. Darkness prevented further observation. In 1911 Carr recorded that a band that he was following had descended from a higher elevation to drink at a spring early in the morning.

Salt licks.—Only one area was found that seemed to be used as a salt lick. This is a region of red rock on the main crest near Baxter Pass; the locality is heavily trailed by bighorn sheep. Droppings found in this area contained a preponderance of red rock fragments. Though pieces of rock commonly are taken along with roots when feeding and appear in most droppings, the concentration of red rock in the droppings near Baxter Pass would appear to reflect a deliberate seeking of minerals. Though this area was observed continually for a period of four days, no sheep were seen on it. Parker, however, states that he often sees sheep bedded there in the red rock.

Mating Season

Duration.—On November 7 mating activity was observed. At this time neither rams nor ewes responded completely, however. It was believed that the rut would not be well started for another few days. On November 21, the next date of observation, the rut was in full swing. If the

five-week mating season that Spencer (1943) found to be normal for the Colorado bighorn is also normal for the Sierra bighorn, then the rut for them would be over by the middle of December.

Mating behavior.—On November 7 observations were made on a band of 3 rams, 8 ewes, 4 yearlings, and 4 lambs during the beginning of the mating season. The rams did little feeding during the day, spending most of the time bothering the ewes. The increased activity of the band as a whole is shown on page 55.

Two of the eight ewes appeared to be in heat. One or another of these was almost constantly being pursued by a ram. The rams assumed a characteristic posture when in pursuit of a ewe, with the neck outstretched, the nose held straight ahead and the head being tilted continually from side to side. The rams did not look where they stepped and often stumbled over grass hummocks, at times proceeding for a step or two on their knees before regaining their feet. They often dashed through the rest of the band, knocking aside individuals that did not move out of their way.

At times while feeding a ram would suddenly receive the scent of one of the ewes; his head would snap up and he would trot off with nose outstretched, smelling each ewe until he located the one that he was after. The ewes would generally trot off as the ram approached and attempt to escape his attentions. At times they jumped to narrow ledges not affording room for the rams and would remain there until the rams moved off. Two or three rams were often in pursuit of one ewe at the same time.

On only one occasion was actual copulation observed, though several incomplete attempts were seen. The ram made two attempts at mounting the ewe before he succeeded. He made only one thrust, then dropped back to the ground. Following this attempt the ram half-heartedly tried twice again to mount the ewe before finally moving off. The ewe stood the entire time with her neck outstretched and her head lowered nearly to the ground. From the number of unsuccessful attempts made at copulation on this date, this period was considered to be preliminary to that of full mating behavior.

Observations by Allen (1939) during the rutting season of bighorn sheep in Nevada indicate that the adult ewes separate from the band and are chased down by the rams. The younger sheep in the band maintain the usual daily routine and are rejoined by the ewes at the end of the mating season. On November 21 further observations were made at the head of George Creek. The only sheep seen were a ewe and a ram that were together, though fresh tracks of others were everywhere.

Earlier in the summer, on July 22, certain actions suggestive of mating behavior were noted on the part of a yearling ram. This animal bothered several of the other members of the band, including a two-month-old lamb, by repeatedly attempting to mount them. He was persistent and butted at the others when they pivoted away from him.

Fighting.—There were two rams present in the band observed on November 7 when it was first sighted. These spent most of their time chasing the ewes and little antagonism was noticed between them. As soon as a third ram appeared the two already present transferred considerable attention from the ewes to him and to each other. The third ram was the same size as the larger of the other two and was continually being molested by one or both of them. Hostility followed a definite pattern. One ram would approach another and stand alongside him so that each stood facing the other's tail. In this position the aggressor would kick with rapid, repetitive upward strokes of his near forefoot at the other's genitals. The shaft of the foreleg was used for striking, the hoof extending between and well beyond the other's hind legs. Often the other of the two originally with the band simultaneously approached the newcomer from the rear and kicked him from that position. During many of these encounters the one molested remained passive and evidenced no sign of discomfort. After several seconds of such treatment he would stroll off and begin to feed. It was obvious that his combative responses were not being sufficiently aroused. Kicking from the broadside stance occurred each time that two of the rams met. It was the only sign of aggression demonstrated between the original two rams. These two often licked at each other's sides after having been kicking each other. This behavior never included the third ram. As the newcomer began to show interest in the ewes, the pitch of the hostility against him increased. On one occasion he was butted on the back of his head by the larger of the other two as they both were smelling the same ewe. The first sign of combative response by the third ram occurred shortly after this incident at a time when all three were in pursuit of one ewe. All suddenly stopped, with the two larger ones facing head to head from a couple of paces apart. With no preliminary actions they suddenly lunged at each other and crashed head on. As they recoiled the younger one lunged at the newcomer and met him head on in the same fashion. From then on for the rest of the day clashes were frequent, sometimes between two and sometimes involving all three. It did not appear that the original two battled each other, though identity of the larger rams may easily have been confused during the observations.

The reports were heard clearly from a distance of three-quarters of a mile. After hitting, the two would stand as they recoiled with their heads down and together for several seconds. Each would finally take a step backward, sometimes immediately to hit again. Often at the report of a collision the ram not involved would whirl about wherever he was and dash over to the scene. In bouts involving all three, two collisions occurred in rapid succession, one ram being hit by the third as he recoiled from hitting the first. The one hit twice was always able to recover his balance during the short interval, however.

Fighting of a more violent nature was witnessed between three rams by Griggs on October 15, 1942, at the head of the North Fork of Oak Creek. He described the action as follows: "Two would stand apart pawing the ground for a time while the third looked on. They would suddenly whirl toward each other, raise up on their hind legs and paw the air with their forelegs for a bit. Then they would drop to all four feet, pause an instant seeming to get set, then leap at each other across the few intervening feet and ram head on, just once. Then they backed off, turned away from each other and commenced to paw the ground again." These clashes occurred every five minutes or less during a period of 30 minutes in the morning and one of 15 minutes in the afternoon during which he watched them. He saw no other sheep about.

This combat may have been due to early rutting season behavior, but the date suggests rather that it was due to other causes. Observations by Mills (1913) and Rush (1942) on Rocky Mountain bighorn show that fighting occurs at other times of the year than during the rut.

Decimating Factors

As explained above, the most critical factor affecting populations of bighorn is the survival of lambs over their first winter. The yearling-lamb ratio of 80:100 present in the Sierra sheep population in the summer of 1948 indicates that there was little loss of lambs over the preceding winter. Another critical factor is survival of new-born lambs. The 80 per cent possible reproduction realized in 1948, as shown by the lamb-breeding ewe ratio of 80:100 and considering the lack of twins, indicates that there had been little loss of new-born lambs. A third factor is decimation in the older age classes. The occurrence of remains of adult sheep is the only evidence available of such mortality. Clues to the cause of death are not often found and so it is not possible to make estimates of the percentage of sheep so affected yearly. Factors that are known to operate in mortality of Sierra bighorn are discussed in the following sections.

Predation.—Golden eagles are found throughout the range of the sheep. The country east of the crest, between Sawmill Pass and Langley, a north-south distance of about 30 miles, is hunted by at least four eagles. I encountered no definite records of eagle predation in the Sierra Nevada, though reports from other areas (Mills, 1913; Ober, 1931; Rush, 1942; Kennedy, 1948; Miles, 1949) show that they take young lambs on occasion and, rarely, even yearlings.

On September 6 I observed the behavior of an eagle toward a band of sixteen sheep, including five half-grown lambs, at the head of George Creek. The eagle flew 10 feet above the backs of the sheep as they were feeding. Three or four looked up as it passed; the rest took no notice. It lit on the ground about 200 feet away from the band, remained there for a moment, then flew to the opposite side of the band and lit again. It finally flew off after another half-minute or so. The eagle definitely was interested in the sheep, though they showed no concern over it.

Mills (1913) and Miles (1949) describe the action of ewes of straddling their lambs so that attacking eagles cannot get to them.

The high survival of lambs in 1948 and of yearlings from the 1947 breeding season would suggest that eagle predation on young animals is not regularly severe in this sheep population.

Mountain lions occur in this region in small numbers. I saw tracks of one at a high altitude on Symmes Creek and during the field work heard reports of three others occurring along the sheep range; no doubt there are more. In a letter to Joseph Grinnell in 1934, M. Hall McAllister told of a sheep killed by a mountain lion that was found in Independence Creek in 1930 by Clyde. The few individuals that are present on the Sierra bighorn ranges are not believed to prey on sheep other than by chance. Any such losses are necessarily small.

Mountain coyotes are common. Sign of these animals was found on the highest ridges and was abundant over the entire range. None was seen though several were heard. Sheep that are weak, snowed in, or very young are subject to possible coyote predation; others can easily escape. Coyotes are not considered to have any measurable effect on numbers of Sierra sheep under normal circumstances.

Wolverines are present but are very scarce. I tentatively identified tracks of one near Dragon Peak and heard reports of tracks of one and two individuals actually being seen in this general section of the Sierra Nevada since 1946. In areas where they are common, wolverines have been credited with occasionally killing bighorn (Sheldon, 1911). They are too scarce to affect the Sierra sheep materially, however.

Bobcats occur on the sheep range but no sign of them was noticed and no reports of them encountered. The only possible effect of bobcats as predators on bighorn would be chance predation on newborn lambs and on trapped or weak individuals.

Ravens are common and according to a report written by F. R. Oberhansley on Yellowstone bighorn, on file at Sequoia and Kings Canyon National Park Headquarters, they are apt to be persistent in attacking newborn lambs. The purpose of these attacks is apparently to pick out the eyes of the lamb. The importance of this species as a decimating factor is considered to be negligible.

Predation is felt to be light on this population of sheep except during abnormally unfavorable winters.

Hunting.—Originally the Sierra bighorns were evidently well able to maintain their numbers in all areas where they occurred, though they were never as numerous as the closely related form in the Rockies (Wheeler, 1876). Hunting by white men probably has been one chief cause of local extinction.

In the more readily accessible mountains of the northern part of the range the sheep were affected early and drastically. Some of the Pah-Ute Indians had been accustomed to kill a few sheep each year before white men came (Muir, 1894), but not enough were taken to affect the total numbers. In addition to being sought as food by early mountaineers, bighorns were killed by sheepmen who considered them to be competitors on domestic sheep range. On the high peaks of the summer range the bighorns were comparatively safe, but when they were driven to low elevations in winter they became vulnerable (Muir, 1898).

In 1883 a closed season was declared on bighorn in California. What immediate effect this had is questionable, for they continued to decrease. In the mountain fastnesses occupied by the sheep, game-law enforcement has been imperfect at best.

From time to time poaching may still occur on certain parts of the sheep range. Some cases of sheep being mistaken for deer occur as do those of deliberate killing. Joseph S. Dixon, former Regional Biologist of the National Park Service, writes that in 1935 he found evidence of poaching on bighorn by a certain group of deer hunters who hunted in the Baxter region each year. Carl Walters has encountered illegal Sierra sheep killings, and others are known.

For the most part the country occupied by the sheep is higher than the average hunter is willing to go for deer, so that the chance of accidental killing of sheep is slight. In a 1940 report on file at the Lone Pine

Ranger Station of the Inyo National Forest, Ivan Sack states that an average of three deer per year are killed in the Thibaut area, which is typical bighorn country. This indicates that normal hunter activity on the sheep range is light. Such casual poaching as occurs cannot be construed as a limiting factor on numbers. Steadily improving law enforcement has brought the illegal kill down to relatively few individuals per year (less than annual production), hence the explanation for present low numbers must be sought elsewhere.

Disease and Parasites.—In at least two localities an epidemic of scabies contracted from domestic sheep was an important cause of diminution in early years. In the 1870s the bighorn in the Kaweah Peaks area contracted it and died in large numbers, according to Hopping. In 1898 or 1899 a similar situation occurred in northeastern Kern County according to Sam Cuddeback, an old resident of the region; it is probable that this was a population of Nelson bighorn. In each of these areas the population appears to have been so reduced by the epidemic that the few sheep left could not survive.

No evidence of either disease or parasites has been found in recent years; all sheep observed by me appeared to be in good condition.

In a letter to Joseph Grinnell, February 14, 1934, S. B. Freeborn wrote that California was then free of scab as all domestic sheep were periodically cleansed by dipping. Presumably, this disease is no longer critical in the welfare of the wild sheep.

Sparseness of the Sierra bighorn population makes abnormal infestations of internal parasites unlikely. Walters states that he has never seen ticks on Sierra sheep in any numbers.

A ram pulled from the Los Angeles Aqueduct in 1938 by Shellenbarger died in a few days from abnormal causes. Shortly before the animal died one of its horn shells fell off. It was found that there were large abscesses between each horn shell and its core. Whether this was due to a pathological condition or whether it was the result of mechanical injury sustained while in the Aqueduct or from other causes was not determined.

Dr. Carlton M. Herman, Parasitologist of the California Division of Fish and Game, attempted to analyze droppings that I had collected for eggs and larvae of internal parasites. The method used was to soak the material in water, then to examine the resulting sediment for larvae. Following this examination the sediment was treated with zinc sulphate in order to increase the specific gravity of the solution so as to float parasite eggs to the surface. Twelve of the 600 samples collected, each consisting of six pellets, were examined and no evidence of parasites was found. This

does not necessarily mean that these sheep are free from infestations of internal parasites, however. Although the droppings were fresh when collected it is possible that subsequent drying destroyed any evidence of parasites. The data, though inconclusive, are negative.

In short, I find no evidence that disease and parasites play an important part at present in limiting the Sierra sheep population.

Domestic livestock competition.—Another factor which Dixon (1936) believed led to decreased numbers of bighorn in certain localities was range competition with domestic livestock. It is known that domestic sheep and some cattle have ranged at one time or another over a large portion of the bighorn range. Grazing control by the Forest Service and Park Service has eliminated much of this direct competition.

Table 10 summarizes the number of animal months of domestic stock grazing permitted in 1947 by the U.S. Forest Service in the country occupied by the Sierra Bighorn. This entire area is included in the Inyo National Forest.

TABLE 10

ANIMAL MONTHS OF LIVESTOCK GRAZING PERMITTED ON SIERRA SHEEP RANGE IN 1947

Herd range	Cattle and Horses	Sheep and Goats	Period
Convict Creek	.....	.....	.....
Birch Mountain	.....	1,800	June
	400	.....	Summer
Baxter	.....	1,200	Apr. 15–May 31
	.....	810	Spring, summer, fall
Williamson	.....	.....	.....
Langley, east of crest	250	150	Spring
	180	175	Summer
Langley, west of crest	9,515	.....	Summer
Totals	10,345	4,135	

Since 1947, permits have been cut down 40 per cent on the entire Inyo Forest, decreasing the number of stock allowed on the portion of the Forest occupied by the Sierra sheep a proportional amount. The greatest number of stock on this range is allowed on the portion of the Langley herd range which lies west of the crest. Here the stock feeds mainly on meadows not normally used by bighorn. On all the other herd ranges, stock are allowed only on the lower portions of the eastern slope and on

the piedmont plain at the eastern foot of the mountains. The regions higher on the slopes above this strip either are classified as impassable to stock or are closed to them. The portions of bighorn range that support the majority of the sheep population—the ranges of the Baxter and Williamson herds—have been subject to little domestic stock grazing in recent years.

During the spring, summer, and fall when stock is permitted on the sheep ranges, most of the wild sheep are ranging at high altitudes so that little direct competition occurs. Bighorn normally feed in rougher places than do domestic stock, even at the lower elevations. However, past overgrazing of bighorn winter ranges may still preclude full occupation of the range by the wild sheep. The grass-herb association along the eastern slope of the Sierra has been widely replaced by shrubs as a result of earlier overgrazing, and I suspect that the climax grass-herb flora was far better winter forage for bighorns. Range recovery is notoriously slow in arid climates, and even after several decades of protection some of the winter bighorn ranges may still be far below their original carrying capacities. This presumed alteration of the range could effectively limit bighorn even if it were confined only to the lower edge of the wintering ground. In severe winters when sheep most need reserve forage they are forced down into the zone of past overgrazing where forage is probably the poorest. Heavy deer populations may also be contributing to current shortages of winter forage. Winter range conditions then may impose a fundamental limitation on numbers. Presumably, complete protection of the whole winter bighorn range from livestock and adequate management of the deer herds would permit a gradual recovery of the sheep population.

The portions of the winter range that are the most critical and that should be reserved for the exclusive use of the bighorn are the narrow belts bordering the summer ranges along the eastern foot of the Sierra. Stock use should be completely eliminated within at least one mile of the base of the mountains, between the South Fork of Big Pine Creek and Olancha Creek. Certain winter concentration points, as the mouth of Sawmill Creek, should receive particular attention. To determine other such areas, particularly along the ranges of the Convict Creek and Birch Mountain herds, a winter survey would be necessary.

Heavy human use.—Dixon (1936) expressed the belief that the steadily increasing number of people occupying the High Sierra in the summer months was an important factor in the decrease of the Sierra bighorn. However, Lowell Sumner, Jr., and James E. Cole, Regional Biologists of the National Park Service, have found in other areas that bighorns, when

afforded complete protection, may accustom themselves to human occupation of their range. It is difficult to judge the real effect of human disturbance on Sierra bighorn populations; certainly the effect has not been good.

Mountain sheep are definitely wilderness game and are naturally possessed of a nervous nature. When hunting pressure is applied, even though only slightly, this nervousness is greatly increased. When disturbance is frequent and there is too little area available to afford required solitude, the sheep are driven from the region as effectively as though they had been killed. In some parts of the Sierra range where sheep have disappeared in recent years, as in the Humphreys Basin area, this combination of events appears to have been the cause of disappearance.

Winter conditions.—Casualties caused by winter conditions appear to be of greatest importance, with heavy snow being perhaps the chief limiting factor. Observations of sheep during and after snowstorms (Muir, 1894; Austin, 1903; Mills, 1913) show that they huddle together in the lee of cliffs or under leaning, dwarfed trees for days at a time if necessary and that few casualties occur during such storms. However, deep, soft snow restricts the subsequent activity of sheep and makes them vulnerable to attack by predators. Most predation on adult sheep can be attributed to their being found helpless in soft snow. The youngest and oldest ones suffer the most in deep snow and are most likely to perish. Snowslides are responsible for the deaths of some sheep. In 1916 Parker found a large ram that had been caught in a snowslide in Charlie Canyon. Other mishaps, such as sheep falling through snow banks and becoming hung in bushes by their horns, and one drowning in a creek after falling through the ice, are reported by Griggs and Shellenbarger, respectively.

Decreased forage supply during a hard winter accompanied by the necessity of increased expenditures of energy in getting about leads not only to deaths due primarily to the snow but also to general weakening and subsequent mortality from miscellaneous causes. The mild winters of the past few years have been favorable for the sheep. However, hard winters that force the sheep down on lower ranges which have been overgrazed by livestock and deer may cause periodic die-offs of considerable magnitude.

Other accidents.—In 1933 a mummified corpse of a ram was found in Lyell Glacier in Yosemite National Park. This animal had a broken neck, believed to have been suffered in a fall some 250 years ago from the cliffs at the head of the glacier, the fall having been caused either by a slip or by an avalanche (Beatty, 1933).

Rocks tumbled from underfoot by bighorn sometimes precipitate large rockslides. These may cause accidents to sheep other than the one that started the slide.

The Los Angeles Aqueduct presents a special problem to bighorn attempting to cross Owens Valley.

Management

Whereas hunting, disease, livestock competition and human disturbance all played a part in reducing the range and numbers of Sierra bighorns, only the latter two seem to present problems today. Continued protection from poaching is of course essential, but neither poaching nor disease appear to be limiting factors now.

As previously indicated, the Inyo National Forest has made substantial reductions in livestock numbers on the east slope of the Sierra and this should permit considerable range recovery in future years. Local overpopulations of deer might likewise be reduced to accelerate recovery, a step now being contemplated by the California Division of Fish and Game. More critical study of the sheep on their winter ranges, particularly in hard winters, may indicate specific localities where range competition is still limiting the bighorns. If every effort is made to restore all portions of the range needed by sheep, some increase is certain to follow. It should be repeated, however, that recovery will be slow, as is always the case on arid ranges; hence immediate results are not to be expected. But over a long period, the absence of livestock on the lower mountain slopes should permit gradual reversion of present brushlands (*Artemisia tridentata,* etc.) back to herbs and grasses which better meet the forage needs of bighorns.

Continued maintenance of the bighorn range as a wilderness is a problem of even greater magnitude. At present no developments are contemplated in this region, but experience elsewhere suggests the necessity for constant vigilance against construction of roads, ski lifts, summer lodges and even improved pack trails. Mountain wilderness is an ever shrinking commodity that should be guarded in its own right. Mountain wilderness with bighorns is even scarcer, and deserves special priority for complete protection.

To sum up, the Sierra bighorn is part of the arctic-alpine climax biota and management should consist simply of preserving that biota.

LITERATURE CITED

ALLEN, J. C.
1939. Ecology and management of the Nelson's bighorn on the Nevada mountain ranges. Trans. 4th N. A. Wildlife Conf., pp. 253–256.

AUSTIN, M.
1903. The Land of Little Rain. New York, Houghton Mifflin Co., 282 pp.

BEATTY, M. E.
1933. Mountain sheep found in Lyell Glacier. Yosemite Nat. Notes, v. 12:12, pp. 110–112.

BLAKE, A. H.
1940. Conference on Sierra bighorn planned. SCB, 25:6, p. 7.
1941. Sheep conference held. SCB, 26:2, p. 3.

COLBY, W. E.
1940. Sanctuary for bighorn. SCB, 25:3, pp. 5–6.
1940. Sanctuary for mountain sheep. SCB, 25:5, pp. 3–4.

COWAN, I. M.
1940. Distribution and variation in the native sheep of North America. Am. Midl. Nat., 24:3, pp. 505–580.
1945. General reports upon wildlife studies in the Rocky Mountain National Parks in 1945. 34 pp.
1946. General reports upon wildlife studies in the Rocky Mountain National Parks in 1946. 20 pp.

DAVIS, W. B.
1938. Summer activity of mountain sheep on Mt. Washburn, Yellowstone National Park. J. Mamm., 19:1, pp. 88-93.

DEPARTMENT OF AGRICULTURE
1941. Climate and man. Yearbook of agriculture. Washington, U.S. Govt. Printing Office. 1248 pp.

DIXON, J. S.
1936. The status of the Sierra bighorn sheep. Trans. First N.A. Wildlife Conf., pp. 631-643.

DIXON, J. S., and E. L. SUMNER
1939. A survey of desert bighorn in Death Valley National Monument, summer of 1938. Calif. Fish and Game, 25:2, pp. 72-95.

FRAKES, W.
1907. Capturing bighorns. Western Field, 10:2, 3, 4, pp. 88-91, 160-164, 250-255.

FREMONT, J. C.
1846. Narrative of the exploring expedition to the Rocky Mountains in the year 1842 and to Oregon and northern California in the years 1843 and 1844. London, Wiley and Putnam. 324 pp.

GRINNELL, J.
1912. The bighorn of the Sierra Nevada. Univ. Calif. Publ. Zoöl., 10:5, pp. 143–153.
1933. Review of the Recent mammal fauna of California. Univ. Calif. Publ. Zoöl., 40:2, pp. 71-234.

GRINNELL, J., and T. I. STORER
1924. Animal Life in the Yosemite. Berkeley, Univ. Calif. Press. 752 pp.

JONES, F. L.
1949. A survey of the Sierra Nevada mountain sheep. M.A. thesis, Univ. Calif., Berkeley. 154 MS pp.

KENNEDY, C. A.
1948. Golden eagle kills bighorn lamb. J. Mamm., 29:1, pp. 68–69.

MANLY, W. M.
1916. Sierra mountain sheep in the Mono National Forest. Calif. Fish and Game, 2:2, p. 111.

MILES, W. A.
1949. Battle of the crags. Outdoor Life Mag., 103:2, pp. 24, 81.

MILLS, E. A.
1913. Wild mountain sheep. Sat. Eve. Post, June 7.

MILLS, H. B.
1937. A preliminary study of the bighorn of Yellowstone National Park. J. Mamm., 18:2, pp. 205–212.

MOFFIT, J.
1934. Grinnell's review of California mammal fauna. Calif. Fish and Game, 20:1, pp. 87–91.

MUIR, J.
1894. The Mountains of California. New York, The Century Co., 382 pp.
1898. Among the animals of the Yosemite. Atl. Monthly, 82, pp. 617–631.

MURIE, A.
1940. Ecology of the coyote in the Yellowstone. Fauna of the Nat'l Parks of the U.S., Bull. 4, U.S.N.P.S. Wash., U.S. Govt. Printing Office, 206 pp.

OBER, E. H.
1931. Mountain sheep of California. Calif. Fish and Game, 17:1, pp. 27–39.

PULLING, A. V. S.
1945. Non-breeding in bighorn sheep. J. Wildlife Mgt., 4:2, pp. 155–156.

RUSH, W. M.
1942. Wild Animals of the Rockies: Adventures of a Forest Ranger. New York, Harper Bros. 296 pp.

SETON, E. T.
1929. Lives of Game Animals. New York, Doubleday Doran and Co. 780 pp.

SHARSMITH, C.
1938. Further observations on the mummified mountain sheep. Yosemite Nat. Notes, 17:3, pp. 51–54.

SHELDON, C.
1911. The Wilderness of the Upper Yukon: A Hunter's Exploration for Wild Sheep in Sub-arctic Mountains. New York, Chas. Scribner's Sons. 254 pp.

SPENCER, C. C.
1943. Notes on the life history of Rocky Mountain bighorn sheep in the Tarryall Mountains of Colorado. J. Mamm., 24:1, pp. 1–11.

TOWNSEND, C. H.
1887. Field notes on the mammals, birds and reptiles of northern California. Proc. U.S. Nat. Mus., 10, pp. 159–241.

WHEELER, G. M.
1876. Notes on the mammals taken and observed in California in 1875 by H. W. Henshaw, in Ann. Rep. U.S. Geog. Surveys West of the 100th Meridian. 356 pp.

WISTAR, I. J.
1937. Autobiography of Isaac Jones Wistar. Philadelphia, The Wistar Inst. of Anat. and Biol. 528 pp.

WRIGHT, G. M., J. S. DIXON, and B. H. THOMPSON
1933. A preliminary survey of faunal relations in National Parks. Fauna of the Nat'l Parks of the U.S. Fauna Series 1. Washington, U.S. Govt. Printing Office. 158 pp.

Last Citadel

By PHOEBE ANNE SUMNER

When we first saw the basin on our map of the southern High Sierra, its striking topography fired our imagination and raised a challenge. Remote from any trail, apparently inaccessible from any direction, it was bounded on three sides by a semicircular wall of giant peaks, and on the fourth by a drop-off equally forbidding and sheer. We had long hoped to enter this primeval area, and when last summer's High Trip brought us near it, we seized the chance to knapsack in.

Eight of us spent the greater part of the first day in working up over the vast, steep fields of rock which provide natural protection for the basin. As we traversed the seemingly endless jumble, we became aware of a sensation new to most of us: at a time and in a part of the world where the opportunity to do so was rapidly vanishing, we knew that this was the way it felt to be pioneers, bound for a land so little visited that it was as if no man had come this way before.

By mid-afternoon the view behind, of wooded slopes, tall peaks, and shadowed canyons, had receded and was forgotten. If the map was right, we were close to our single point of entry to the basin; we had climbed to 13,000 feet and were approaching its rim. To our left now were the summits of its towering, serrated, upper wall, the westernmost of which would soon obscure the sun. A cloud stole briefly over a low point on the crest, and dissolved.

Soon afterward we stood triumphant on the basin's rim; far below us lay its rugged wilderness—barren in its upper reaches, with twisted trees and green meadow patches farther down, its gray rocky surface broken by small, shining lakes. But what made it all unique in our experience was that great wall, which revealed to us no other breach. The invulnerability of the wall was in its height and its loose and treacherous rock—rock which mountaineers shun gladly.

An eagle circled high in the slanting light as we started down; and by the time we had made our way, over rocks which slid with every step, to relatively level ground, it was almost dark. As we looked around this mountain fastness in the twilight, hunting for a place to camp, our sense of isolation and remoteness grew. There were no old campsites here, no marks of axe or fire. There was only the murmuring of the stream, the faint night wind, the light of the stars.

When we awoke next morning, it seemed to us as if each separate beauty of the High Sierra had been gathered here, to be preserved and guarded for all time. This hidden stronghold formed a self-sustaining world; the white snow patches where the streams were born, the pines and willows and soft meadow grasses watered by these streams, the little animals and birds protected and fed by the plants and trees—all these things in perfect equilibrium, requiring nothing from outside their granite home except the sun which brought them warmth and light, the clouds which brought them rain.

First reactions to this untouched loveliness retold another story. "If only we could live here!" someone cried. "If only the others could see this too!" The fisherman mentally stocked the stream with trout; the skiers stocked the slopes with down-mountain courses. But to such thoughts the basin and its living things had answers. We sensed these answers as our feet pushed through the waving meadow grass, untrampled since time began, and we thought of other meadows we had known; as we walked through clumps of giant foxtail pines, unblazed or thinned by man, blackened only where lightning had struck; as we picked our way along the stream bank and shining lakes, past waters as clear and pure as they had been a thousand years ago; as we watched a cony busy in the piled-up rocks; as we listened to a rock wren's song—and thought of forests, waters, and creatures known no more.

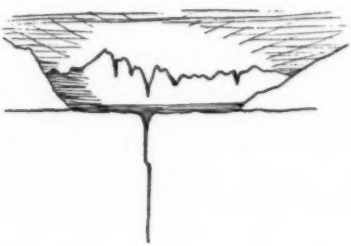
Slowly we understood the implications of the knowledge, now made real, that here was something which once a continent had possessed, something which had thrilled men's hearts as they looked over the unbroken western prairie; the great marshy valley of the San Joaquin teeming with wildfowl and big game; the untrodden Yosemite—something which had retreated and retreated until now it must hide between a sheer precipice and a giant wall, deep in the lonely reaches of the mountains.

We found ourselves doubling our usual care to leave no sign that we had passed. We spoke less frequently of coming back some day; stopped planning to tell others by what route we had come. Better perhaps if we could tell them why.

Late on this second day, while we stood beside a quiet lake and looked back toward the far end of the basin, an uneasiness which had grown steadily upon us took shape in words. It was as if the spirit of the place were speaking, within its voice the echo of other voices which were silent now, because men had not heard.

"Here is a different wealth from that which most men understand. It may not be gained by blasting these rocks, felling these trees, damming this stream; it could be lost forever in an hour. To try to take this treasure is to lose it. Leave it unchanged; the gain will not be yours alone, but every man's.

"You who have walked otherwise through all the earth, walk gently here."



Beyond the Barrier

By PATRICK D. GOLDSWORTHY

"How would you like to be my 'hoss' for a month?" asked Cedric Wright. Being familiar with his sense of humor, I said yes, little realizing what was to follow. It was this way. Cedric Wright, as photographer for the Sierra Club High Trip, required someone to carry his camera equipment, which was getting too heavy for him as the years rolled on and he kept accumulating more of it. I saw in this job a chance to learn photography from one whose technique I admired, as well as an opportunity to see the real Sierra Nevada, where I had long hoped to hike and camp. What I experienced that year, and since, exceeded anything I had expected, and has resulted in a treasure of memories which I have never ceased to enjoy.

This first High Trip for me, in 1940, was viewed entirely through the eyes of the faithful and obedient hoss, who would leave camp early with Cedric to catch sunrise pictures and arrive late for dinner after having photographed the silhouetted mountains and their lengthening shadows. In the years following, my observations of the High Trips were made successively: from the bottom of the big black pots as Bruce Meyer and I chipped out burned mush; once again, as I trotted along behind Cedric carrying his equipment; from beneath the bellies of the mules and among piles of food as I sorted boxes and sacks of supplies; and then this year, first, through clouds of dust from the restless mules while breaking camp and finally, while pausing for breath and putting up a red arrow in my dash to reach the next camp site ahead of the tireless high trippers who constantly threatened to overtake me.

Working with Cedric permitted one to see the trip from a guest's point of view. Leaving camp early and spending lots of time on the trail resulted in a leisurely feeling and permitted one to meet many people. The responsibility was minimal and consisted mainly of being the photographer's beast of burden. Scrubbing pots, moving supplies, and breaking camp resulted in leaving very late, and necessitated hiking rapidly to the next camp in order to help with the evening meal. These three responsibilities, which were increasingly greater and more inclusive, made it ever more difficult to find time to relax and meet the guests. Finally, this year, it was once again possible to see the trip as a guest would, partly at least. The move was always made in great haste ahead of everyone; but in camp,

since the work was delegated to those who had done such a good job in the past or to others whom we wished to train for the future, there was more time to circulate and talk to the people. This freedom was partly offset, however, by the responsibility of assisting Dave Brower and later taking his place when he left.

The responsibility for the High Trip started as early as February and increased steadily as July drew near. It was of a planning nature, and the decisions were made on paper and involved numbers of men and mules, days, miles, crates, pounds, sacks, and cans. From the day of arrival in Mineral King, the responsibility did not decrease, but remained heavy, with an occasional higher peak whenever a crisis arose. There had to be on-the-spot decisions involving personalities of people and mules, safety, changes of itinerary, amusement, education, and principles of conservation.

As the news of the first wreck on the High Trip arrived and the seriousness of it became reflected in the anxious and worried faces of those who had already arrived at Mineral King, the first crisis of the trip seemed to be upon us. A car had gone off the road and "thrice had showed its ugly underbelly to the sky before it came to rest." With the arrival of Bob Lipman and his passengers, the crisis evaporated, leaving only a note of warning and caution and a feeling of relief and gratefulness.

The rest of the last day in civilization was utilized by many people in as many different ways. Cars were parked and secured against rain; letters and cards were written; each car that arrived was scrutinized carefully and hailed enthusiastically when the passengers were recognized; mules and horses were shod; some people repacked dunnage to weight specifications, others, more methodical in their plans, weighed their already packed bags, only to see whether bathroom scales at sea level read the same as spring scales at eight thousand feet; commissary equipment was sorted, rejected and augmented; the road-end store was confronted with a demand that threatened to exceed the supply; and a new system of checking and segregating supplies was being inaugurated.

The mountains, which had their feet planted in Mineral King and surrounded us on three sides, rose steeply in the east to form the Great Western Divide. All day I had been wondering what was to happen to us beyond this huge barrier, against which the waves of civilization were constantly beating. In some parts of the mountains these waves had in a sense eroded the scene, as witnessed in dams, roads, and logging and mining scars; in other places, the erosion was imminent but could still be

prevented; here, only the spray from the waves topped the crest, to be seen as discarded cans and bottles.

Then it was moving day, and our turn to top the crest, but not to erode it. I jumped up out of a sound sleep to the sound of the alarm clock, to be greeted by the utter darkness of four in the morning. It was time to wake Dave so that he could rouse the camp with the wolf call. Those who had air mattresses or, because of years of experience had prepared comfortable beds, were reluctant to get up. Others, who were less fortunate and had spent a miserable first night on rocks, cones, and twigs, were grateful for a chance to get up without attracting undue notice. While the guests were dressing and packing their dunnage with the inadequate aid of flashlights that threw more shadows than light, breakfast was being started. Flames from the pot and tub fires as well as the two stoves threw light upon the commissary stage and warmed the actors who were waiting for their cues. Ted Grubb came on first, carrying buckets of water from the deep shadows of the river bank to the soot-covered kettles with their shiny interiors. Rubbing the sleep out of their eyes, the rest of the actors and actresses stumbled over low rocks hidden in the shadows as each played his part in preparing breakfast and packing up. Before we knew it, the people had left and were halfway up the slope to Timber Gap. The mules, finally rounded up and harnessed, arrived to be loaded down with kyacks we had barely finished packing, pots and utensils which were still wet, and stoves and irons that were still warm. It was a pleasure to see commissary, the packers, and the people so well organized so early in the trip. This was an early indication of the excellent coöperation among the three groups that was evident throughout the ensuing weeks. It is this coöperation, coördinated with the plans of the management, that makes the High Trip really successful.

The day's trip from Mineral King to River Valley was really a game of fox and hounds, with the packers as foxes, the people as hounds and straw being dropped to lay the trail. This game has been played before by the Sierra Club during the course of many High Trips. The trail of the fox has been marked in many ways, by ducks, orchid paper, dehydrated-apple pie slices, and directing arrows. The first of these clues blends with the landscape; the last is removed the same day by the management; and the rest disintegrate after the first rain. There is another more subtle form of this game, however, where the trail is marked by a few hounds who have been intently following the fox. Here, the markers, which show the way, are often indestructible and would remain for years. However, since it is the obligation of all Sierra Club members and the duty of the

assistant manager who leaves camp last to remove all evidences of our campsites and passage along the trail, the thoughtlessness of these few is compensated for.

The River Valley camp, our first in the wilderness beyond the barrier, was where we became orientated, acclimatized, and acquainted. It was a transition between civilization and the high open granite country we were headed for. Here the mechanics of living in the mountains were explained to instruct the newcomers and refresh the others. Instruction and review in map reading, rock climbing for various degrees of skill, and blister control were presented by the management. Those who had already learned the arts of washing, making bed sites, finding the burlap, and getting fed, passed the information on to others less fortunate. The adjustment to our new environment was a rapid one and soon we were ready to leave the oak trees for the juniper and albicaulis.

After having assisted in packing up commissary equipment, putting out the fires, burying the ashes and filling in the garbage pits and burlaps, Ted and I were ready to follow the last of the mules which had already left for Hamilton Lake. Ahead of us Anne Brower, Jane Goldsworthy and Charlotte Mauk had been forced to rest because of a wreck caused by one of Smokey Bye's neurotic mules. This mule had earlier indicated his dislike for vegetable crates by refusing to stand still whenever one was to be put on his back. Finally, Smokey, with his powers of persuasion, both physical and oral, gained the upper hand, or so he thought. However, there had been slack in the cinch and the mule only waited for an opportunity to use it. The chance came at an abrupt rise in the trail. The crate was retrieved two switchbacks below and repacked, only to be discharged twice more within one hundred yards. Smokey, who was also very determined, refused to recognize that the odds were against him until the crate was thoroughly demolished against a tree.

Such wrecks are unpredictable variables which have many consequences, depending upon the load being carried and the scene. Food may be lost or delayed, resulting in menu changes; equipment may be damaged, sometimes beyond repair; or dunnage may be ripped open or soaked. Except for dunnage trouble, commissary usually is able to improvise. Improvisation on this day consisted of our gathering up the contents of the smashed crate and carrying them the rest of the way, much to Smokey's amusement.

Hamilton Lake, high above the oaks and surrounded by open granite, was our first real High Sierra camp. Here everyone found time to follow his own inclinations to work or relax. There was a combination primitive

laundry and public bath across the stream from a concert that mixed Beethoven, ballads, and jam session. Some people, short of breath from swimming in the icy water, were sunning themselves on the hot granite rock. Others, seeking complete relaxation, read, talked to their friends, or watched an eagle gliding on an updraft of air from the bottom to the top of the huge cliffs across the river—an ascent of a full two thousand feet without so much as a flap of his great wings. To his eyrie the music drifted faintly until long after the full moon had silhouetted the peaks and had made a silvery path across the lake.

The climb as we left Hamilton Lake was rapid and led us to more triumphs of trail engineering. Rounding a sharp corner, we came upon the remains of a suspension bridge which had been built across a chasm some twenty years ago, only to be carried away by an avalanche of rock and snow within a year. Pete Garner, who had crossed it, told of the excitement of getting a string of loaded mules across. A solid log bridge can present an obstacle, mostly mental, to a mule, but can't compare with an undulating, swaying suspension bridge. A tunnel now goes through the granite bluff that had been avoided by the bridge.

After passing through Kaweah Gap and sitting down to eat our lunch by the first snow of the trip, we could see our next camp less than half a mile away. Since it was only noon and the commissary mules had not come by with the stoves and food, there was no point in hurrying. Also, almost everyone had reached the site before noon so everything was well under control. Here was a chance to relax and enjoy a jam and snow sherbet with one's lunch and then to lie down for a quiet nap.

Reaching Big Arroyo so early allowed lots of time to rest in preparation for the various excursions and activities to take place in the next few days. Here started the first of many side trips which were to augment the regular itinerary. This was a knapsack trip, led by Bill Davies, to Chagoopah Plateau and points beyond for the benefit of those who would not be with us when we camped there in the second two weeks. Francis Farquhar led a group who had camped at Moraine Lake before and wished to revisit it. Others, who had their eyes on the peaks and lakes in the immediate vicinity, were given ample opportunity to explore the four cardinal points of the compass, including Nine Lakes Basin, Eagle Scout Peak, Mount George Stewart, and Red and Black Kaweah. The last of these was the most spectacular, and, with its hazard of crumbling and falling rock and history of tragedy, presented a real challenge to the mountaineers. On the way up, Jules Eichorn's sharp eye noticed something moving in a small rock crevice; deep within it was the nest, occupied by young, of a rosy

finch—a rare discovery indeed. With the aid of a belay rope and a mirror to reflect sunlight, Bill Hail was able to get a color motion picture sequence of the birds for the Sierra Club's summer-trip film. By the time the summit had been reached some threatening clouds brought rain, followed immediately by a brief snowfall; when this cleared, we saw something we had not noticed before. Off to the south was the first glimpse of a forest fire we were to see at close range later on. When first sighted, only a thin column of smoke rose into the sky, but by evening this had mushroomed into a very ominous cloud.

It wasn't necessary to climb a mountain to find a bird's nest, however. A hermit thrush had nested in the low branches of a pine right next to the men's burlap. The constant procession of bird lovers brought forth various comments. It was requested that in the future the management either locate the facilities in a previously explored area, or that the birds be asked to move elsewhere.

We rounded up our stay at Big Arroyo with a campfire in packers' camp. Ivan Hansen sang a song in his native tongue, but he was too young an Indian to translate it; Bud Steele, after disposing of the Devil, introduced the pride of the Mount Whitney Pack Trains—a talking mule—and the program was concluded by Bruce Morgan, who called square dances until no one could stand any longer.

Little Five Lakes was the next camp on our itinerary and the last for most of the people, who were soon to leave for home. To make the last few days more pleasant the management arranged for a little rain in order to settle the dust. The optimist could be distinguished from the pessimist by the way he reacted to the rain. The former merely covered his belongings with a tarp, while the latter took great pains to construct elaborate shelters and drainage ditches sufficient to cope with a cloudburst. The pessimists were probably governed by the darkness of the clouds immediately overhead and memories of the 1946 trip, when it rained on eight consecutive days. Whether the rain was responsible or not, the fishing was excellent, judging by the culinary efforts of Clara Armstrong at the fish fire. The sight of rows of golden brown trout being expertly fried was a delight both to gourmets and photographers.

While the fishermen were enjoying themselves, others were swimming, washing, rock climbing, or preparing for a display of their constructive or acting talents. Various mobiles and abstracts, expressed in wood and paint or wire and tin, contrasted with natural wood forms and shapes at the traditional bandana show. The talents of some were displayed by sketches, paintings, or ingenious labor-saving devices, while the person-

alities of others were reflected in displayed bandanas, lines on weathered palms read by the Hermit ("Army" Armstrong), or four-footed contestants in the mule show. The final display of talent took place at the Freshman Radio Show, produced and directed by Gurney Breckenfeld and Sanford Marcus. Their commercials were inspired; my favorite was, "Try Diorite, recommended by leading dentists all over the country. Guaranteed to remove those ugly surface teeth. Remember! Wake up and Diorite!"

The camp was awakened early the next morning by the Clarke crows and commissary's rendition of the Star Spangled Banner, and everyone prepared for the parting of the ways. Dave was leaving the mountains and leading most of the people directly over to Sawtooth Pass (via two knapsack passes) and out to civilization. I was to be left to lead the rest of the trip. The weight of the responsibility was great, but the commissary and the packers had been well broken in, and I knew that I could rely on support and assistance from the guests. With a firm handshake and a friendly smile, Dave wished me luck and led off to Mineral King.

For us, the four-weekers, it was a long day's move, well marked in ephemeral white, where Don Scanlon and I left the real trail and followed deer trails. In one place, we went over a cliff and down a steep sandy chute. Little did I realize that later that day a string of mules was to follow us, and was henceforth to be called Gilmore's Flying Mules. Fortunately, the ensuing wreck, which involved mostly the library and the office kyacks, was not serious. Pencils, paper, books, and records were eventually picked out of bushes and gathered from the surrounding countryside.

At Rattlesnake Creek, I boldly chose my first campsite and marked out men's, women's, and married camps, hoping that when the new group arrived from Mineral King there would not be too many complaints. After that there wasn't much to do but wait for the people and mules to arrive. The burlap locations were designated and excavation begun; sites for the pot and tub fires, the stoves, and the garbage pit were selected; and the necessary stove construction and digging was started. Wood was also collected, both for cooking and for a small campfire. As the people wearily dragged in by twos and threes, they would slowly wander around hunting for a comfortable spot to lie down and rest. It was a long, hard cross-country trip even for the hardy ones who came into camp along with the lengthening shadows. Others, accustomed to traveling

slowly or hampered by blisters, arrived long after dark. One by one, each regained enough of his strength to get back on his feet and take an interest in what was going on.

It was getting late, with still no sight of the mules, and we thought of the terribly steep trail from Soda Canyon up to Little Claire Lake. Earlier that day, after having traveled along the sandy bottom of Soda Creek in the scorching heat, it was all we could do to climb up that steep trail. Stopping to rest repeatedly, we would look back down where we had been climbing and hope that the packers got up there before dark, as a wreck seemed inevitable. Everyone by now, assuming the worst, was turning to, to improvise what appeared to be a meager supper when we heard wild yells from high up on the side of the canyon. The packers were coming, even as daylight was getting dim. It was Charlie and Louis with the food and equipment and a little dunnage. Here was our supper-to-be, and with a wonderful display of group spirit, everyone helped prepare the meal. Since Jack Heynemann, carrying the dunnage, was still out, as well as some of the slower hikers, I really started to worry, especially after hearing about the wrecks that Charlie and Louis had had.

After eating supper and cleaning up, we all gathered around a small fire to wait for the last two hikers and Jack. For a while we all participated in a very informal friendly conversation. Gradually the pauses between comments got longer and longer as various heads began to nod. Unable to keep awake any longer and lacking sleeping bags, the guests suggested bundling as a solution, which was sanctioned by the management. Shortly after midnight, the dunnage and the last of the hikers arrived, much to everyone's relief. Jack had climbed up out of Soda Canyon in the dark without mishap, only to lose the trail in an open sandy area.

We awoke to see once more the smoke from the forest fire. It appeared very ominous now that it was only a few miles away. There was much speculation whether the fire blocked our path or not as the smoke appeared to be coming from the junction of Rattlesnake Creek and the Kern River. Soon after breakfast, our fears were dispelled by talks with a number of men on horseback, who carried shovels and led strings of mules carrying supplies and equipment. They were all on their way to the scene of the fire which was on the opposite side of the Kern where it was joined by Rattlesnake Creek.

Hardly had the dust from the fire fighters' animals settled, when the second two-weekers started to arrive. They also had stories to tell about the fire. Truck loads of food and supplies had been arriving at Mineral King since the time we first spotted the fire from Big Arroyo. Many truck

loads of fire fighters from all over the state had been brought in along with pack animals. Radio equipment connected top-ranking personnel with those who were on the fighting line. Periodically, the progress of the fire was charted on a large map. Weather reports and forecasts of wind direction and speed were constantly being received and used to predict the movement of the fire. The whole scene, which might have been taken directly out of George Stewart's book, reminded me of an island beach head with its problems of logistics and communications.

The newcomers, after resting the remainder of the day, were invited by Paul Pfeiffer to go on a short hike to Little Claire Lake. He, as well as the rest of us, was much impressed by its unique beauty, wished to go back there once more, and felt that those who had not seen it should be given a chance to do so. He led the group up to the lake, where they cooked their own supper and then relaxed to enjoy the beauty of the sunset light on the mountains as they looked eastward down Soda Creek and toward Mount Whitney. Coming back by flashlight, the group generally agreed that Little Claire was really a delightful spot for swimmers, fishermen, and photographers alike.

Passing close enough to the forest fire to see the flames, we moved to Upper Funston Meadow, a camp which was poor for such a large group as ours, as it was hot, dangerously dry, smokey, and very crowded. At this point, amoeba-like, we sent out our first pseudopod—a side trip led by Ed Wayburn to Mount Whitney. Next, when we moved to Moraine Lake, Dr. Cutter was left in charge of those who wished to stay and fish in the Kern. Finally, at Moraine Lake two more parties were sent out—one to the little-explored Kaweah Basin and the other to Little and Big Five Lakes. On all these trips the same group spirit that we had first felt at Rattlesnake Creek was present. There was always that feeling of pride, self-assurance, and a realization that they had enjoyed the temporary independence from the main group, but were glad to come back and tell the others what a good time they had missed. This feeling of friendship, coöperation, and independence delighted the small groups.

Other people, less venturesome, found plenty to do at Moraine Lake. Whatever our diversified interests were during the day, in the evening we all would walk out to the western edge of the plateau, where we could see for miles in every direction, and watch the sunset. Dropping away at our feet was Big Arroyo, which seemed filled with purple haze. Farther west, rising out of the shadows and silhouetted against the evening sky was the Great Western Divide, a barrier between civilization and wilderness. Low clouds, like fog, were pouring through the passes, only to be

dissipated as they drifted down the eastern slopes. Looking eastward, we watched the purple shadows pushing the sunlight farther and farther up the slopes of the Sierra Crest until finally only the very top of Whitney, beyond the deep blue of Moraine Lake, seemed to glow from within as it reflected the last rays of a sun which had already set for us. In a matter of moments it was all over. The Range of Light, from Mounts Muir and Whitney to Junction Peak, Diamond Mesa, and beyond, was finally engulfed by the deep shadow of night. Film and mind both had recorded the scene.

Feeling grateful to Cedric for having told us about this beautiful place, we all gathered around the campfire to enjoy the program and get warm. The fire was just below the edge of the plateau on a small bench. With our backs against the granite bluff, we could watch the peaks framed between the two camp fires, getting ever less distinct against the darkening sky. Before starting down from the bluff after the campfire, we would take a last look around. The sky, filled with more stars than we had ever believed possible, seemed to have been washed and polished until every star sparkled crystal clear. Southward, where the sky blended into the darkness of the mountains, there were also spots of light. These were not bright and sparkling but irregular and yellowish. The forest fire was still burning.

Then began the interesting experience of seeing, either with or without flashlight, whether one could find the way back to his bedsite, or would end up in packers' camp, commissary, the camp of the opposite sex, or miss everything altogether and wander around with the grazing mules.

We ended our delightful stay at Moraine Lake by plunging over the edge of Chagoopah Plateau down into Big Arroyo, only to climb up to the head of Lost Canyon, our last camp. All the side trips had ended successfully and everyone was back in camp. The guests were concentrating on absorbing as much of the mountains as possible in the remaining several days. The sweeping grandeur of the view from Moraine Lake was rivaled by the colorful sunrise and sunset we had at Lost Canyon. Cedric, ever on the watch for pictures, realized the potentialities of the clouded sky, a forerunner of the coming thunderstorm. With his camera set up ready to catch just the proper lighting at the right moment, he was the center of an amusing scene. Admirers who hoped to achieve the same quality in their photographs were mimicking his every move.

While the guests were reminiscing over the trip which was soon to end, commissary and the packers were planning to terminate the operation. Equipment was counted and greased, the extra food was tabulated, and

plans were made for sending everything but dunnage eastward by pack train to Carroll Creek for winter storage. Plans for improvement of design and method were discussed with Bruce. Words of thanks and encouragement were exchanged by guests and commissary.

Leaving the mountains is always a sad occasion, but this time it was an exciting one also. An unstable air mass lay over all California and was swelling the clouds into huge thunderheads. From the top of Sawtooth Pass we could see the towering cumulo-nimbus in all directions hurling lightning at the surrounding peaks. Remembering the Bugaboos and not wishing to get wet, we left the pass to hurry down to Mineral King. *Crash!* A bolt of lightning which practically blinded us, followed by deafening thunder, had struck directly across the canyon from us less than a quarter of a mile away. By then, the solid curtain of rain which had been approaching steadily from the south reached us. It was cold and wet and in a matter of seconds we were drenched. The water poured off the top of my head and down my face and neck. It was impossible to wear my glasses. We were so wet that instead of being miserable and uncomfortable we were highly amused and laughed at each other's drowned appearance. We could at least be thankful that we did not have to roast in the noonday sun as did the first two-weekers on this rugged trail.

Soaked, but happy, Jane and I arrived at the end of the road to be greeted by Anne and Dave. I was happy and relieved to tell him that everybody came through in one piece and that everyone without exception coöperated so well that the trip seemed to run itself. Dave once more had the major responsibility on his shoulders, that of concluding negotiations at Mineral King and making the final settlement with Bruce. While Dave, in his white shirt and pressed trousers, discussed business, Jane and I retired to clean up a little and get into dry clothes which were clean—at least by mountain standards.

One by one, as belongings were loaded and farewells were traded, we climbed into the waiting cars and started down the road. We had a pleasant feeling of tiredness and satisfaction and were already thinking, perhaps subconsciously, of next year's trip.

Some Thoughts About Avalanches

By WERNER GROB

THE PAST YEAR has brought forth two new works* on avalanches, a field about which very little has been written in America. These two works are of great interest to all who hope that more general attention will soon be given to this important subject.

Both publications have been prepared in mimeographed form, and for this reason unfortunately will not enjoy large general circulation. Both have been written by public servants, men of great practical experience in their field.

On the other hand, these two reports show many antitheses: M. M. Atwater, snow ranger in Alta, Utah, and F. C. Koziol, Supervisor Wasatch National Forest, intermountain region, limit themselves to avalanche conditions in one place, the well-known old mining town of Alta. They present their material and documentation in a most detailed and complete fashion, and in a way that would be possible only for them to do —for it is based on the observations and measurements made day after day with untiring accuracy over a period of ten years. André Roch's report, however, is based on a quick survey trip that he made from January 26 to April 24, 1949, to 16 different skiing areas of the West, at the invitation of the National Ski Patrol System. His report, therefore, cannot be based on many observations covering long periods of detailed study of local conditions. But Roch's report is by no means superficial, for reasons we shall give presently, and it augments ideally the Alta Studies as a contribution to American avalanche research and understanding; the very difference between these two reports makes them of all the greater value in giving a whole picture. Roch is a trained expert in scientific avalanche research; his training and his knowledge are based on hundreds of years of experience on the part of Swiss mountain people, and on many decades of specialized study on the part of Swiss scientists.

Atwater and Koziol cannot have the long background of tradition and experience of Roch. They had to start from scratch, making thousands of observations from numerous avalanches, finding out in which way they

* *The Alta Avalanche Studies,* by M. M. Atwater and F. C. Koziol. U.S. Forest Service, Department of Agriculture. (96 pages, 46 being of photos, tables and graphs).

Report on Snow and Avalanche Conditions in the U.S. Western Ski Resorts, by André Roch, Federal Institute for Research on Snow and Avalanches, Weissfluhjoch-Davos, Switzerland. (27 pages of text, plus five sketches and 30 photos.)

were similar and in which way they differed from one another, and hoping in this way to arrive at some general truths which could perhaps be applied at other times and in other places. It is the old principle that man in his quest of knowledge has had to follow from time immemorial—first collect all the empirical data available, then generalize it into an abstract principle that can be generally applied.

But it has been proved at Alta that even the laborious quest of pure empirical knowledge can often lead to heartening practical results. Since Alta became a skiing center ten years ago, only two persons have been caught in avalanches and only one of them killed. This is to be ascribed to good organization and man's dependability (i.e., warnings to skiers and closing downhill runs). However, when Alta was an old mining town it was feared as a place where hundreds of persons had been offered up as sacrifices to the inexorable avalanches. Of the two avalanche accidents in "modern" Alta, both occurred in regions that had been declared closed by the snow ranger; the two skiers had disregarded both oral and posted warnings that the area was unsafe.

The Alta Avalanche Studies gives an admirably thorough presentation of the specific snow and avalanche conditions in Alta in the following aspects: terrain analysis, climate analysis, avalanche characteristics, contributory factors, avalanche hazard forecasting, and avalanche protective measures. In an annex there are nine separate addenda dealing with the organization of avalanche rescue operations, standard snow terminology including avalanche terminology, Alta explosives operations, safety organization, case histories of avalanche accidents, and climax avalanches —"avalanches which run at long intervals, but with climactic violence."

I can have no doubt but that *The Alta Avalanche Studies* will largely serve their purpose, which is to show the personnel of the Forest Service, stationed in areas open for skiing, what are the principal problems connected with avalanches, and what precautionary measures are possible and available. If I doubt, however, that the *Studies* will form the basis for future avalanche control in the United States, it is because I believe that Atwater and Koziol ascribe far too little importance to the metamorphosis of snow and the study of various snow layers. The explanation for this attitude might be found in the specific climatic and weather conditions that are typical of Alta—relatively frequent and heavy snowfalls, generally followed by low temperatures and dry weather, which often result in a compact snow cover, showing no great differences (after the soft snow avalanches caused by the new snow have disappeared). It might be mentioned at this point that André Roch, when he visited Alta, dis-

covered that the snow layer there was rather homogeneous and compact, without big differences in the quality of the snow and without very distinct layers. It is a fact, however, that the snowflake undergoes a metamorphosis from the very moment that it comes to rest on the earth or on the old snow. This metamorphosis consists of a change from the delicately designed flake to a compact grain, or even a newly condensed crystal. This change takes place at varying tempo, all according to temperature, humidity, and pressure. Because of the various layers of snow which form themselves in the snow cover in accordance with the above-mentioned factors, snow metamorphosis has a very great influence on the formation and probability of avalanches. The remark made by Atwater and Koziol that the examination of snow layers by ram-sounding rods and procuring of ram-profiles is troublesome and of no great importance, may be correct in part as far as the special conditions at Alta are concerned (how about the so-called "climax avalanches"?), but it does not take into account sufficiently that the conditions in other places are relatively not so simple and uncomplicated as in Alta, and that it is not necessary to have a ram-profile of all slopes in order to form an opinion of avalanche danger.

The avalanche service immediately set up by the Swiss Army at the beginning of World War II for the climatically greatly varying Swiss Alps made very profitable use of the snow ram-profile. These profiles (normally one per week and per observation field) present in a graphic manner the resistance that the different layers of snow offer to the penetration of the ram-sounding rod, and give a description of the snow quality of the different layers by means of symbols. Resistance and snow quality give a very good picture of how compact the single layers are, and of how great the danger that single portions could break away.

There can be no doubt in my mind that a more thorough and complete study of these elements of snow and avalanche research and the tensions in the snow cover created by the nature of the terrain and the packing of the snow, will enable Atwater and Koziol within a very short time to make further big forward advances. In an examination of the mechanical causes of an avalanche there will result a generally valid knowledge that will apply equally at another time and in another place. But we should not aim to go too far: it will never be possible to figure out the exact hour, or even the day, of an avalanche break in advance. This can only be possible to a limited extent—for instance, for loose-snow avalanches, which are caused by the adjustment to the maximum gradients and are different for every snow type, grain size, weight, etc. For the rest, we should be satisfied with describing the degree of avalanche danger. This will make

it possible for all interested parties, the snow rangers, lift operators, and also skiers, to act accordingly—that is, to close some downhill runs at times, to blast certain avalanches, and to avoid some areas or slopes completely.

André Roch's *Report* is divided into the following sections: Introduction, diary, technical reports on the districts visited (Berthoud Pass, Loveland Pass, Arapaho, Aspen, Mineral King, Squaw Valley, Sugar Bowl, Mount Hood, Mount Baker, Stevens Pass, Snoqualmie Pass, Alta), and Conclusion. The technical reports are of interest not only to skiers and operators or promoters of these areas but they are also interesting to a wider circle of readers because of the general comments and proposals that they contain. Roch examines the individual skiing areas, their runs, lifts, approaches, with an eye to avalanche danger, avalanche prevention and control; and he gives suggestions for future developments and activity. He also takes the opportunity of correcting certain incomplete impressions current in this country of Swiss avalanche science, its uses and tendencies. Differing from *The Alta Avalanche Studies*, with their far more complicated system, he explains why the Swiss classification distinguishes only two basic types of avalanches. The only factor considered for this classification is the mechanism of rupture of the avalanche. All other factors can be taken care of by the various subgroupings of the two types: slab avalanches, and loose-snow avalanches.

In his conclusion Roch points out that it is not possible to avoid all accidents from avalanches. "How the avalanche occurs is now no longer a mystery, and the approach is to study first the condition of snow deposit and its metamorphosis and, secondly, the mechanism of the sliding of the snow layer. The way avalanches start depends on the climatic conditions of each place. When the influence of these conditions is known, the degree of danger can be established and adequate measures can be taken." It becomes necessary then in each single area to decide whether permanent control measures are advisable for roads, lifts, areas and runs, either by holding the snow in the rupture zone, by diverting the avalanche on its course, or by direct protection of the object threatened by permanent construction, such as triangles, walls, or fences. The other possibility, which is always used whenever permanent constructions are too expensive, is to blast the slope from time to time.

Roch warns against our regarding the closing of downhill courses or of whole areas as the best recourse against avalanche danger. It is impossible to close all slopes menaced with avalanches during all periods of danger without greatly handicapping the skier, and in case of an accident

on a slope that has not been closed, one must count on the relatives' suing the authorities in charge of avalanche-control measures. Instead, Roch believes that the best development is to be found in creating a net of snow-observation posts throughout the entire skiing area of the country, which would be manned by trained persons who would constantly check on the development of the snow cover and meteorological conditions, and give periodic reports on the degree of avalanche danger. Lacking sufficient trained personnel, it is also possible to carry on only snow and weather observations at the spot, and leave the judging of avalanche danger up to specialists at a few central offices, who would make their predictions on the basis of ram-profiles, snow descriptions, weather charts, etc. Once a week, these reports should be condensed into bulletins which would be made public in the newspapers and over the radio. If these avalanche bulletins were to give not only the degree of avalanche danger but also a description of the conditions leading to the critical situation, then the skier would become accustomed to pay more attention to avalanche danger in planning his ski excursions. Roch is convinced that such education of the skiing public would provide by far the best guarantee for fewer avalanche accidents.

Based on his observations, Roch differentiates three different climate zones in the West which he suggests should be taken into account in future avalanche work:

1) The wet western climate with very heavy snowfalls and wind. It results in dry slab avalanches only during the coldest period of the winter. Very thick slab avalanches and heavy wet snowslides occur all through the winter, especially during and after snowfalls. Then, the situation stabilizes quickly owing to the warm weather. In this climate belong the Cascade Range in Washington and Oregon, extending south perhaps as far as Mount Shasta.

2) A drier climate with heavy snowfalls, such as found in the Wasatch Mountains and the Sierra Nevada in California. Here the avalanches are numerous during and after every important snowfall, and the snow usually packs quickly because of the thickness of the snow layers. Inside the snow cover, however, some layers may stay soft and cause much bigger avalanches of several older strata later on. This kind of avalanche will hardly happen in the first zone except during cold winters. He would put in this zone, Alta, Reno, Mineral King, etc.

3) The third zone will be characteristic of the Rocky Mountain climate. Dry snow and very cold temperature. Frequent light snowfalls, heavy temperature gradient in the snow cover speeding up the metamor-

phosis of the snow, which then does not pack any more. He would suggest here a further classification in: (*a*) zones with much wind, such as at Berthoud Pass; and (*b*) zones with less wind, such as at Aspen. The avalanche danger will be more frequent in the second zone because it can come rather unexpectedly.

The Alpine climate could be placed between the second and third zones mentioned above—not as dry and as cold a climate as zone 3, and snowfalls not so important and frequent as in zone 2.

In closing, Roch mentions that he wrote two releases in the course of his stay in the United States ("The Task of the Avalanche Service," and "Condensed Guide to Avalanche Dangers"), and he adds a bibliography of literature available on the practical side of the avalanche problem.

He also mentions that he would find it a good idea if a delegation of forest rangers, patrolmen, and lift operators were to spend a while in the Alps, and were to observe and study there at first hand what the winter-sports resorts are doing for the prevention and control of avalanches.

In the United States until now areas in avalanche danger zones have for the most part been avoided by roads, railways, towns, and ski developments because the land reserves of America are so vast that it has been easy to by-pass them. However, if skiing continues to develop at its present pace in this country, and if the areas suitable for winter sports are to be opened by highways and railroads, and equipped with resorts and lifts, then it becomes essential that better knowledge and understanding about avalanches, their prevention and control, be made available. It ought to be possible to create an organization comprising all interested parties and covering the entire country, and that would take into account not only practical work but also scientific research. For the latter, a snow and avalanche research institute, similar to the one on the Weissfluhjoch in Switzerland, should be set up through a university or technological institute. It would see to the training and research projects of scientists, as well as serving as a center of special instruction for snow rangers and patrolmen. Not only the National Ski Patrol System, the National Ski Association, the Forest Service and the National Park Service are interested in such an organization, but also the Army. Military historians are fully aware of the tragic lesson of World War I, when within the 24-hour period of December 12-13, 1916, no less than 10,000 soldiers were killed by avalanches on the Austro-Italian frontier. A total of 80,000 soldiers lost their lives on this front in avalanches during World War I, a greater number than were killed by the enemy on the same front.

Letters to the Editor on Avalanches

1. *From John Sieker, Chief, Division of Recreation and Lands, U. S. Forest Service, Washington, D. C., April 6, 1950:*

WE ARE glad to send you the enclosed letter from Messrs. Koziol and Atwater . . . which discusses Mr. Grob's article. As you know, the work done at Alta by Koziol and Atwater is the only real avalanche study and control work the Forest Service has undertaken. We fully recognize the local character of the specific information and data obtained at Alta but we also believe that many of the principles established at Alta can be successfully applied in other western mountain terrain. Mr. Herbert observed conditions at numerous western winter areas the last two seasons and feels confident that the *Alta Studies* will be of significance if intelligently applied to other areas.

Much more work on avalanche study and control will have to be done before we will feel satisfied. Research and application of the best available data to meet local problems will have to be done concurrently until we have much more reliable information.

In the meantime we will welcome the suggestions and criticisms of our good friends from Switzerland who have a much greater background of study and administration than we have. We are glad to see Mr. Grob's article published because it will help stimulate public interest in a big problem which is of great concern to the public and to us as administrators of many public ski areas.

Some of Mr. Grob's statements are naturally of concern to Koziol and Atwater, who have pioneered avalanche-prediction and control techniques in America. We feel that there is little to add to their statement, but want to emphasize the relatively small size of Switzerland compared to the United States, and the fact that in Switzerland large numbers of people—often whole communities—are constantly associated with the avalanche hazard, which makes the approach and solution to the problem in the two countries somewhat different.

The Forest Service agrees with Roch's warning against closing downhill slopes as the best recourse against avalanche danger. This type of passive protection is used as a last resort only, and the table on page 6 of the *Alta Studies* shows that total closures at Alta have been almost nil during the past few years. However, from a public-safety standpoint we believe it better to close a slope, when other methods of reducing the hazard are not possible or available, than to take the chance of someone's being hurt—even if the closure action handicaps skiers. We do not feel

that an avalanche-warning service which Mr. Grob advocates is enough or even practical in the U.S.A., except on a localized basis. In addition to warning skiers, experience indicates that supervision on the ground is necessary to enforce restrictions when they become necessary at heavily used ski areas.

2. *From F. C. Koziol, Forest Supervisor, and M. M. Atwater, Snow Ranger, Wasatch National Forest, Salt Lake City, March 3, 1950:*

MR. GROB'S review of *The Alta Avalanche Studies* and the André Roch report have been read here with interest. The Forest Service and particularly the authors of the Alta study feel that the reaction of a man who has had direct contact with Swiss snow techniques is valuable to our own work. The more we can compare notes with other agencies studying the same problems, the better for all of us.

We are a little concerned about one statement in Mr. Grob's article. He doubts "that the *Studies* will form the basis for future avalanche control in the United States." The balance of the article proves that Mr. Grob does not mean to dismiss offhand the avalanche work which has been done in this country. Naturally he is partial to the Swiss approach with which he is familiar. But his statement, we feel, is based on a misunderstanding of our problems and our aims. We wish to state that unless and until some better practical methods are developed which will fit the conditions of Western U.S.A. as far as the Forest Service is concerned, the Alta studies are, and will continue to be, the basis of future avalanche control.

Beyond question, the Swiss are preëminent in snow research. We are indebted to them for the fundamentals of our work. *The Alta Avalanche Studies* are not research in the strict sense of the word and not intended to be. They are not comprehensive and do not pretend to be. They are a technical study and a field manual designed for the use of administrators. The avalanche-study organization of the Forest Service at this time consists of one man, stationed at Alta. However, it makes no difference to an avalanche whether it happens in Switzerland, California or Utah. If the terrain and climatic conditions which produced it are recognizable, can be recorded and analyzed, then the data are valid whatever the source or method. That there are avalanche-producing combinations not set forth in the *Studies* is granted. The most obvious thing about snow research in any country is the fact that we all have a long way to go before we know most of the answers.

To one of Mr. Grob's statements we must offer a flat contradiction.

Nowhere in *The Alta Avalanche Studies* is it written that "the examination of snow layers by ram-sounding rods and procuring of ram-profiles is troublesome and of no great importance." André Roch got the same wrong impression that we underrate the value of the ram sonde.

For the first five years of avalanche studies at Alta, those assigned there made regular snow profiles (ram sonde not available then) in an effort to develop some correlating factors that would help in determining the probability of avalanches. No such correlations were apparent, so the troublesome shovel method of making profiles was dropped. It was convincingly apparent early in the study that other factors such as the primary ones listed in the *Studies* were far more important and subject to quick diagnosis, which is something every snow ranger must be able to do if he is to administer safety in his area in a manner to give the public greatest possible margin of safety on ski slopes as well as on approach highways.

We would like nothing better than to adopt the ram sonde as one of the tools of our trade. But on the basis of our experience we cannot agree that a single ram profile is valid for an entire locality. It may be in Switzerland. It might be elsewhere in the United States. It certainly would not be at Alta as was dramatically illustrated during the series of slab avalanches which took place here during the last week in March, 1950. Under intensive artillery fire we found one slope avalanching violently, while its neighbor of the same general exposure, elevation, grade, and aspect refused to budge. On one major slide path we even found a mixture of slab and windpack. The slab avalanched; the windpack could not be dislodged. Would a ram profile taken on the canyon floor, or even on some safe and practical point on the slope itself, make this distinction? We think not. We can easily see that placing too much confidence in ram profiles could easily lead to trouble in the Wasatch Mountains and numerous places elsewhere. In our hands the ram sonde would be a tool for discovering questionable layers on specific slopes known to be favorable to the formation of slab and as a preliminary to blasting. (Where the slopes are too distant or too inaccessible we will persist in our practice of taking a shot at them periodically whenever our weather factors indicate that they might be dangerous.)

The discussion of snow metamorphosis is rather elementary. Anyone concerned with snow studies is, we are sure, thoroughly conversant with the subject. There would appear little need to duplicate fundamental knowledge generally available, especially when practical experience and many observations throw doubt on practical application under conditions encountered in western United States on many national forest ski areas.

Swiss problems of snow safety differ from ours, although they arise from the same threat. In Switzerland, the avalanche hazard is concentrated. In the United States it is widely dispersed in distance, and as André Roch described so well in his report, in climatic factors. The Swiss snow safety organization is therefore closely integrated on a national basis. Ours must be decentralized entirely on a local basis, at least for many years to come.

In Switzerland, the principal hazard is to people already in the danger zone, either inhabitants, soldiers, or visitors living in hotels. In the United States we have no developed alpine-type ski area which cannot be very positively protected. Our other principal hazard is to people traveling from the cities on the plain to the ski resorts in the mountains and passing through the danger zone.

The Swiss people are much more conscious than ours of the avalanche hazard. They do not have brief contact with it over a week end. They live with it. Therefore they are willing to allot substantial amounts of money for snow research and avalanche protection. Our people are just beginning to realize that avalanche hazard influences a much wider area than a few ski resorts—that railroads and highways, telephone and power lines, industries and homes, and people engaged in many activities other than skiing for fun, are in the path of this destructive force.

But even should public interest provide the funds for training, equipment, and men, we doubt if we should copy the Swiss organization exactly or seek to duplicate its work. Experience indicates it will be more profitable for us to follow a different path. André Roch's investigations of the load-bearing characteristic of slab will eventually make of the ram sonde the tool it was meant to be. Our studies of the combination of wind force and rate of new snowfall will be equally valuable for an entirely different type of hazard. It is a formula that can be understood and used by practical administrators and not be limited to technicians and engineers.

We do not want these remarks to be construed as a rebuttal of Mr. Grob's article. His criticisms are frank and constructive and therefore valuable. Neither are we blindly determined that our snow-safety techniques are the best and only ones. Though effective, they are far from perfect and we are eager for any improvement adaptable to our means. So far it is only a dream, but the Forest Service has long wanted to send some of its men to Switzerland for training. André Roch's personality and technical accomplishments made a deep impression in this country. We learned a great deal from him and know that we could learn a great deal more by studying with him and his colleagues on their own ground.

3. *From Werner Grob, Director, Swiss National Tourist Office, San Francisco, April 15, 1950:*

I BELIEVE it was Voltaire who said that if Cleopatra had had a longer nose, world history would have taken a different course. In variation, I could state that "if Alta had different climatic conditions, the work of Koziol and Atwater would have come to a different result." In other words, if Alta had less frequent but heavier snowfalls and greater extremes in temperature, more attention would have been paid to the development of the snow cover and its strata, and, as a result, to the mechanism of rupture of the avalanche, in the valuable research of these two American pioneers, who cannot be praised enough for their work. And this is still in my opinion (a Swiss can be as stubborn as a Missouri mule!) a prerequisite for all general and not purely local avalanche work.

Concerning work with the ram-sounding rod, the *Alta Avalanche Studies* are rather less outspoken than the impression I seem to have given. The part in question reads: "This process is interesting, but has obvious limitations for the snow observer. In the first place he has neither the time nor the facilities to make ram profiles of an entire ski area. In the second place no ram profie can tell him when or under just what conditions a slab is going to break off." To answer the second point first: This is not the purpose of a ram profile, but the differences of compactness of the different layers describe the general degree of avalanche danger—the special degree of danger for a specific slope has to be established by taking into further consideration its topographical and other characteristics which influence the mechanism of rupture. As for the first point, it is a fact that for this purpose one ram profile per ski area (resort area) will be enough because the history of the snow layer and temperature, etc., will be the same for the entire area. I admit as one possible exception a situation in which some part of an area were always to get a lot of sunshine and another never any at all.

As far as the question of temporary closing of slopes and areas is concerned, I agree with Mr. Sieker (rather than with André Roch, whom I was only quoting) that it is not possible (also not in Switzerland) to rely on the reasonableness and coöperation of the skier to voluntarily avoid danger zones. There are plenty of case histories of avalanche accidents in Switzerland to bear out the reckless attitude of some skiers. It should be a requirement that the responsible authorities of an area have the right, and exercise it, of closing the runs affected in case of avalanche danger.

High Angles in the Eastern Alps

By ALLEN P. STECK

THE SNOW was falling thick and heavy on the Adlersruhehütte high up on the east ridge of the Gross Glockner; it was near dusk and the occupants of this highest refuge in Austria were busily drying clothes, preparing meals, or merely chatting to pass the hours. The hut keeper had just set a bowl of soup on the table when Karl and I stumbled into the room, cold, shivering, and half-exhausted from the drain upon our energies during the last nine hours. We stood there, the water dripping from our drenched clothes, forming a pool at our feet, and felt glad that it was over. We had come through.

"You fellows won't do much tomorrow; this weather's here to stay," said someone who had just come up to us; "Where've you been? up there?" he asked, at the same time pointing toward the summit. "Yes indeed," said Karl, "but we go down tomorrow; we have climbed up through the Nordwand," he added briefly—for emphasis. He had a way of making these startling statements with a half-smile on his lips; then he would watch the follow with a careful eye to note the effect. "You are mad," was the reply; we settled down to tell of our ascent.

It all went back to a warm summer evening in the first week of July, when Karl Lugmayer—student of Physics in Vienna and member of the Austrian Alpine Club—and I were standing in front of his home in Wolfern. We saw shadowy fields reaching out to the horizon from our feet; but our mind's eye, far from the tranquil beauty that surrounded us, flew to more distant regions. The Dachstein, the Kaisergebirge, and the Glockner group were all to be part of our tour; then we crossed over into northern Italy, to the sheer cliffs of the Dolomites. Here we would spend several weeks climbing on the Tre Cime di Lavaredo, the Civetta, Cima della Madonna, and the wonderful, sound rock of the Vajolet Towers. Then, continuing on across northern Italy, through the fertile valleys and over high mountain passes, we would finally arrive in the small village of Courmayeur; and, climbing up and over the Col du Géant, close to the southern ice slopes of Mont Blanc, we would find ourselves, at the end of our tour, in the Chamonix Aiguilles.

That same evening, when our one hundred and sixty pounds of luggage had already been fixed on the racks of the bicycles, Karl's family came out to bid us farewell and we rode off into the shadows.

The Nordwand had always been the object of Karl's eager ambitions, in fact, the name itself held a sort of chilling fascination for both of us. The rain pattered softly on the pavement as we arrived at the Franz Josef Hotel, found at the lower end of the Pasterzen Glacier. The new snow wouldn't help the condition of the 1500-foot ice wall on the north face; the air was too warm and the snow would be wet. The Oberwalderhütte was our immediate goal and lay three hours up the glacier, directly opposite the main peaks of the Glockner group.

At 3:30 the following morning, we were rudely awakened by our pocket alarm. During the night a fresh breeze had come up and swept the skies, and outside the moon shone down on the Glocknerwand, accenting the ridges and buttresses with a startling clearness. We paused at the window, looked out over the darkened snows, and Karl clasped my shoulder: "This is our world," he said.

We tumbled down the stairs, collected our gear, and made a quick breakfast. Ice pitons, carabiners, warm clothes, bread and cheese—all went into the sack along with other essentials, and we soon were on our way down to the glacier. Once across and up on the opposite slope, we put on our climbing irons and began to feel our way through the icefall that drained the snowfields under the north wall. Karl's ax sparkled in the sun as it fell methodically into the ice under the 'schrund. With the aid of a piton, he was soon over the top and climbing up the steep snow. "Come along," he called down some minutes later, and I climbed up to the piton and slipped it out of the ice with my finger. Arriving at his belay spot, I sunk my ax into the hard snow, coiled the rope over the head once, and motioned him on. He stepped up onto the fifty-five degree slope and, catlike, crawled up the snow until he had drawn out all his rope; then he made a new belay point. Time passed quickly as we worked up on the wall; the crunch of iron on snow, an occasional shout, and the hissing of the small snow avalanches in the center of the slope were the only sounds that penetrated the silence. The sun had come up and was softening the layer of snow that covered the ice. Above were the final rock buttresses.

Standing in a small niche hewn out of the snow, we paused for a minute, and became suddenly aware of the threads of mist curling about the summit and the dark clouds sweeping the glacier below. The air was ominously still and warm and the snow became soft and slushy. Karl was leading out across the center of the couloir where all the debris that fell from the upper flanks was funneled. The snow slid away from under his crampons, leaving the two front prongs barely biting into the water ice. I leaned a little heavier on my ax, loosened the coil around the head, and

waited. Quickly, he cut a small hold for his hand, calmly and methodically chopped a step for his right foot, then continued climbing.

It was two in the afternoon and we had close to a third of the wall yet to make. Instead of climbing directly upward, kicking the two front prongs of the crampons in the hard snow, we had to cut steps. Off in the distance came the sharp crack and dull roar of thunder and lightning. As we reached the rocks, it began to snow—a soft, wet snow—so, we elected to try the route over the buttress directly to the peak rather than trust the couloir which led upward into the swirling mists. The climbing went a good deal faster on the rocks; most of the holds were solid and the ledges frequent.

I had just passed Karl and was leading up a chimney, when there came a blinding instant of thunder and fire, so close that we felt the jolt run through our limbs. The sound died away, and we stood there listening to the buzzing of our axes as they discharged into the air. "Beautiful music," said Karl, rather too philosophically.

No time for waiting now; after the first wave, we started up the couloir again, hoping to get down off the summit before the next blast. The snow fell thicker and we began to feel the bite of the cold.

Several rope lengths under the summit, more bolts crashed into the cliffs and ridge; with the tragedy of Bugaboo Spire still strong in my mind, the overwhelming helplessness of our position was even more evident. What more could we do than climb on and trust to the mercy of the mountain gods? And so we continued as quickly as possible and reached the ridge only a short distance from the summit. Crossing over to the Kleinglockner from the summit on a thin snow ridge, we descended quickly to the Adlersruhehütte and safety.

FOR MANY years the towering gray cliffs of the Kaiser, though they are in northwestern Austria, have been the climbing garden for the hardened, high-angle mountaineers of Munich. But, now, owing to border restrictions and military regulations, the ordinary German cannot cross over into the Kaiser, so the classic routes of the early 'thirties are more or less left to the equally capable climbers of Vienna and Innsbruck.

The peaks and buttresses of the Kaiser form a range some seven miles long and about two miles wide. Routes of every conceivable difficulty can be found, some requiring acrobatics on a level with those used on the Lost Arrow. The rock is hard, solid limestone, rising in vertical walls and scattered with good, sound hand- and foot-holds.

On the northern slopes of the Kaiser, under the picturesque north wall of the Totenkirchl, we found the Stribsenjoch Hotel, owned and operated by Peter Aschenbrenner, member of that tragic German expedition to Nanga Parbat in 1934. He stayed there most of the year, climbing only if some of his friends came by, and occasionally descending the Kaiser valley to the town of Kufstein.

The Fleischbank southeast wall, for the ascent of which we actually came to the Kaiser, was all that it was said to be. The weather was good, although that wasn't saying much, for a severe storm could come up in a matter of minutes. And once you have started the climb, you are obligated to finish it; actually, there is one exit route on the wall in case of storm, but it is hard to find. Only eight months before, a party of four from the Austrian Alpine Club of Vienna, friends of Karl, were overtaken by a severe thunderstorm half-way up the wall and were forced to bivouac standing on thin ledges. Before rescuers could reach them three had perished. These routes required the utmost in judgment and endurance.

The first third of the wall was relatively easy, though several pitons were used both for safety and for direct aid. The first difficult rock work was a forty-foot pendulum traverse that led out onto a vertical, smooth face. Karl worked up on tension to the high piton and fixed his rope into the sling; then I lowered him several feet so that the radius of his swing could carry him far enough out on the rock. Several persons who were walking along the trail five hundred feet directly below us paused to watch Karl as he swung out on the wall, trying again and again to reach the holds that would bring him across. But again and again he slipped back. But at last he made a vigorous push and with difficulty managed to reach the small hold. He hung onto the fingertip ledge, then slowly, with delicate balance, inched over, using his feet for much-needed friction, and reached the bucket hold. He tied in, and I swung out on the wall and followed. Once by his side I untied and pulled the rope through the sling. We were now committed to finish the climb.

Several leads of ordinary class-six variety went by; the famous Rossi overhang was won through the use of double-rope technique; and we finally found ourselves under the final five hundred-foot, nearly vertical summit wall. We knew exactly what was ahead—two class-four leads up a steep, open chimney and then the awesome traverse known as the "Ausstiegriss"—the exit crack. In a small cave, above the chimneys, I stepped up on Karl's shoulder and, using cross pressure in the crack above, worked up to the first piton and fixed a foot sling. I saw the next piton four feet above, but could find at first no way to reach it. This is

the clinch, I thought to myself; and, going up on delicate holds and cross pressure, I reached it and snapped in my carabiner just in time to avert a fall. The crack turned almost horizontal and for the last twenty feet led across a slightly overhanging wall. Concluding that it would take a fingertip traverse and the help of a piton or two, I grabbed the lower lip of the crack, worked across to the great ledge, and the climb was ours. This lead was extremely exposed; Karl remarked later how wonderful it was to look down directly into the emptiness below; but while I was leading I never seemed to have the time to notice it.

At the border between Austria and Italy, 20 miles south of Lienz, we stopped and cast a fond glance back over the retreating mountains of our beloved Austria. I say "our" with feeling, for in the course of the few months that I was with Karl in the Kaiser, the Dachstein, and the Rax, or with his family in Wolfern, the feeling came to me that Austria was almost as much a part of me as it was of Karl.

But we turned our eyes southward again and saw the towering cliffs and precipitous spires of the Sexton Dolomites. Behind this horizon, somewhere, was the tremendous north wall of the Grande Cima,* an ascent of which we had frequently and eagerly discussed.

An official took our papers, stamped them, and, muttering something to himself about mad climbers, dismissed us with a farewell. The whole aspect and tempo of life changed before our eyes; a new language fell on our ears; there was gaiety, laughter, and untiring activity.

Our first view of the Tre Cime was a thrill that we had long awaited; the Grande Cima rose more than 2,000 feet from talus to summit, glowing with that characteristic yellowness of the Italian Dolomites. We climbed on the Piccola Cima, waited out a storm the second day, while it deposited snow on the ledges of the Grande, and on the third day we made ready to tackle the north wall.

We climbed up easily to the beginning of the first difficult lead at about eight o'clock in the morning. There we stopped on a spacious ledge and looked up at the wall. For some eight hundred feet it rose vertically right from our shoulders; in fact, it seemed to sway out into the sky over our heads. Icicles, falling down from the heights above, twisted and whirled in the air, until, a full sixty feet from the base of the cliff, they struck the rocks. It seemed amazing that this wall had been climbed, but there were the pitons, arching up before our eyes in the yellow rock. Karl took

* Climbers may be more familiar with the non-Italian *Grosse Zinne*.

the ropes, and tying into the ends, started off to the left. Using double-rope technique he reached a piton some ten feet above me and then hung there on it while he surveyed the route above; he called down in a rather surprised voice that he could see no more pitons for twenty feet, and that the wall was still quite vertical. Then I saw him reach up and gave him slack; he began to climb freely with little holds and delicate balance. Surprisingly soon he called down, "Al, I've got it!" With difficulty he pulled the slack through the carabiners and gave me tension. I swung out and snapped the ropes out of the rings and was soon by his side. I anchored in, and he traversed out to the right in order to get into the crack that led up to the next ledge.

But we never got to see the ledge that day, for in the next few minutes there was a near catastrophe. He reached the crack and inched up about ten feet. There he stopped and, fearing that he might run out of rope, suggested that I come across and belay him from the foot of the crack. On a small ledge, six inches wide, I belayed him with my right hand while holding onto the rock with the left. He was in a difficult spot just below a bulge in the rock; but since the pitons were placed, the procedure was primarily mechanical. With a determined effort, he raised himself up high on the piton. As he struggled to reach a hold, the rusty piton pulled out with a jarring suddenness. He flew headlong past my shoulder. The rope was jerked from my grasp and the whole length of it went through the five carabiners before he was finally brought to a halt by my counterbalancing weight and friction of rope and carabiners. I looked down after that frightening moment, not knowing what I would find, and there was Karl, climbing up to the ledge where he had started, rubbing his head! I fixed the ropes into a rappel and descended from one of the higher pitons. The distance from this piton, lower than the blessed one which held him, was easily ninety feet.

"Yes, Al, we had luck there," he said, and grinned. "I must have turned two or three times in the air. It was a beautiful feeling, falling like that. Never even felt the rope tighten about my waist when I stopped. Yes, it was the steepness of the wall and the nylon rope that saved me. We were both to blame—you for not belaying properly and I for not testing that old piton! But let's not talk about it any more."

Since he had suffered a sizable cut on his head, we hiked down to the village and found a doctor to patch it up as best he could. When he heard the details of the fall, he threw up his hands at our madness. But what really excited him was our telling him that we were going back that same night to the hut, and early the next morning would again start up the wall.

Around ten o'clock the next morning we reached the scene of the accident. I took the lead and climbed up to the rusty stain on the rock where the piton had been and found that one of the rocks was completely loose, probably owing to freezing during the recent winter. I put the same piton back in a crack a little to the right and went up on tension to the spacious ledge—all of a foot wide. Karl followed, with a large white bandage over the top of his head and tied under his chin. Since he was still a bit dizzy, I started up the next pitch. We went on for several hours, making about another two hundred feet, which brought us to the famous "escalator" lead. Here the crack, a hundred feet high, required the use of about twenty-five pitons, all for direct aid. This was the lead that defeated many of the first attempts on the north wall.

Twelve hours after we had started we reached the Aschenbrenner bivouac ledge, named after the man who made the second ascent of the wall. Pounding in several pitons with great determination, we anchored into them and crawled into the nylon tarp which was to serve as our sleeping bag. We started on before the sun came up. The climbing was much easier, for the wall was now only about seventy-five degrees and there was no need for pitons. At ten we stood on the summit in the morning sun, the first time we had felt its warmth for a day and a half.

Two days later, on the way to the steep, 3600-foot northwest wall of the Civetta, we passed through Toblach and met some friends of Karl's from Vienna. Seeing his bandage, they asked if he might be the one who "flew down the north wall of the Grosse Zinne, and lived to laugh about it." The news traveled even to the Rosengartengruppe, where we did some climbing later on.

"I think this [the fall] will prove to our climbers the value of nylon ropes," Karl wrote in one of his recent letters, "the only trouble is . . . that we can't afford them!"

Karl came down to Genoa the day my ship was to sail for New York. We stood on the pier and talked of many of our pleasant, and unpleasant, experiences; of the time when he would come over to America, perhaps, and climb on the friendly cliffs of the Yosemite, which I had so many times described to him. He was a sincere admirer of nature; loved to tour on skis in the spring; deplored the existence of rope tows and chair lifts.

I can still hear his parting remarks, just before the ship pulled away from the dock. "The next time you come, Al, we will go only for the good ones—the Eigerwand, the Grand Jorasses Nordwand, and the Matterhorn Nordwand! We've had our taste on the Glocknerwand."

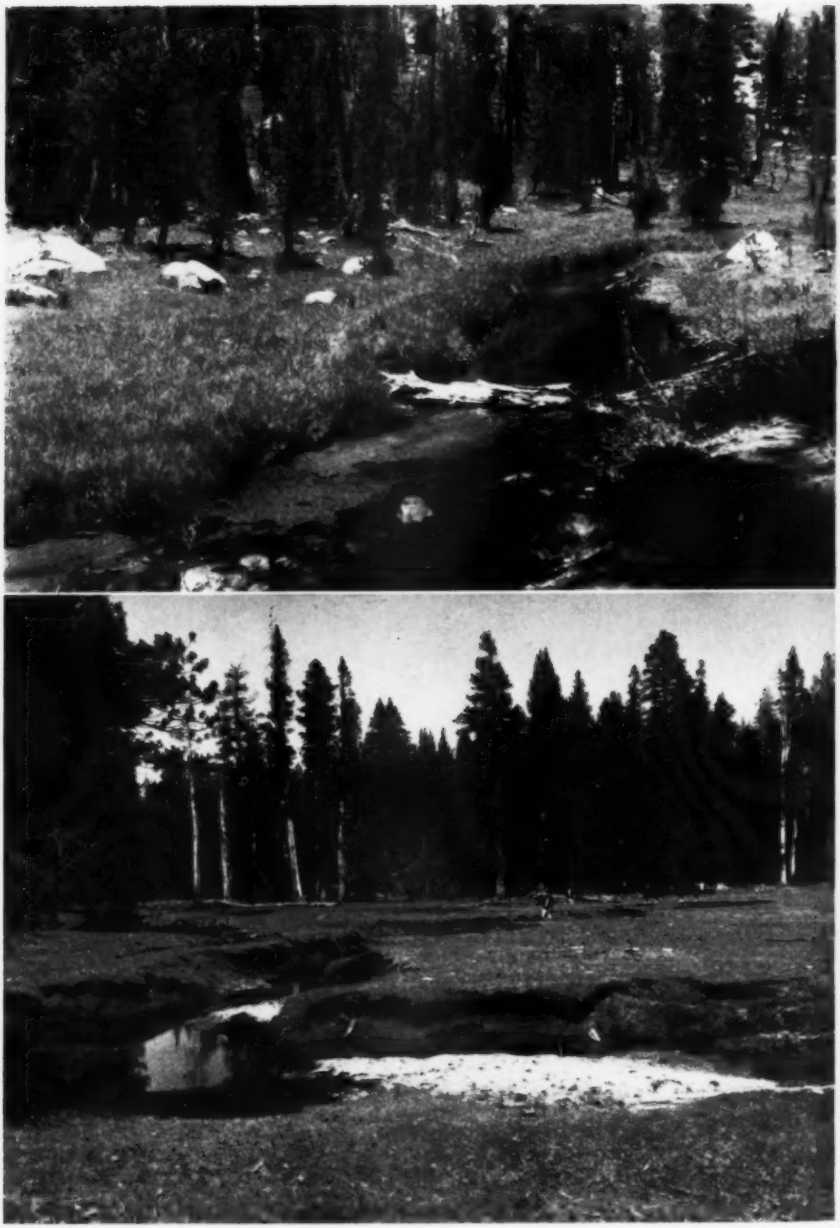
If I know Karl, he will give them a try long before I ever get back.

STORM NEAR LIENZ — Allen P. Steck

THE GROSSGLOCKNER NORWAND — Allen P. Steck

(Above) Sierra Club commissary, and part of a breakfast line. Gives an idea of the volume and variety of items packed, including two stoves at right of center, weighing about 175 pounds each.

(Below, left) The Sierra Club garbage pit during use. Tin cans are burned, then smashed flat with sledge hammer. *(Right)* Same garbage pit after fire was extinguished with about 20 buckets of water, earth replaced, and many loads of pine cones and duff scattered over the site.



(Above) Undamaged meadow in the seldom-visited Lost Canyon. Sod extends unbroken to water's edge—a sign of health. Compare with picture below, which illustrates the usual condition.

(Below) For comparison, an overgrazed meadow is shown here. The trampled sod collapsing along stream banks, and lowered water table, are diagnostic. Most Sierra meadows look like this today.

Reports and Comments

HIGH TRIP OPERATIONS: A SECOND STUDY SEASON

By Lowell Sumner and David R. Brower

Following up last year's survey,* a study of the club's annual High Trip operation, as modified from the procedure of previous years, was made again from July 4–31, 1949, in Sequoia National Park, Brower being on the first two-week period and Sumner on the second.

Proportionate Damage, Large Parties vs. Small.—In 1948 the party had consisted of approximately 173 persons, served by 52 pack animals and 21 saddle horses. This gave a ratio of .42 animals (roughly, half a mule) per person. In the comparable first two-week period of 1949, there were 169 persons, served by 48 pack animals and 22 saddle horses, giving an animal-to-man ratio of .41. For the second two weeks, the enrollment was lower, dropping to 130 persons, but the number of stock could only be cut to 64, so that the animal-to-man ratio rose to .49.

The impossibility of cutting down the number of stock in direct proportion to a reduction in enrollment illustrates a law of diminishing efficiency that would commence to operate if a large outing group were drastically reduced. It takes just about as much equipment and as many staff members to prepare a camp and cook for 130 people as it would for 170. Unless the entire commissary set-up, time-tested over many years, were to be altered, there are just as many cooking kettles, whether full or not, with an enrollment of 130, and just as many workers needed simultaneously to carry on the complex but efficient operational procedure. In addition, on the basis of 130, the operating costs of the trip exceed income to a serious degree.

Conversely, the outing group, and the operating efficiency, could be substantially *increased* without materially increasing the number of livestock. That is because the number of kettles and other items of equipment would remain nearly the same in spite of the increase. Dunnage and food, it is true, would increase at the rate of 30 pounds of dunnage and 40 pounds of food per person added. However, the number of pack animals would increase very little, even if the enrollment rose to about 200, because of the shuttle system now in effect. Under this system each mule usually makes more than one trip when moving from one campsite to another. To illustrate from past records:

Persons	Livestock	Head per man
130	64	.49
169	70	.41
194	76	.39

Use of Hay.—The procedure for protecting badly overused meadows at the first stop beyond the road end was carried out on an even larger scale this year than last. During the first two weeks of the High Trip, July 4–16, Redwood Meadow had been scheduled for the first night's camp beyond the road end at Mineral King; however, this small meadow was found to be in such poor condition, partly as a result of the drought, that two substitute camps were made, at River Valley and Hamilton Lake.

It was necessary to stop one day at River Valley, and to lay over again at Hamil-

* *SCB*, 34:6, 140-143.

ton Lake, so that the mules could catch up on their shuttle service. Still another stop-over for the same purpose was necessary at Nine Lakes Basin. Finally, at the fourth camp site, at the upper end of the Big Arroyo, the mules were able for the first time to bring all the food and supplies together at one camp. For eight days they had been fed hay at and en route to River Valley while traveling across to Mineral King and being used on shuttle service between the road end, River Valley, Hamilton Lakes, and Nine Lakes Basin.

This prolonged hay feeding cost the club in the neighborhood of $100 per day, or $800, for protecting the mountain forage in the area. Such an expenditure illustrates forcibly the law of diminishing returns in hay feeding at a distance from a road end. It so severely strained the club's budget for the annual High Trip that some other procedure, involving less extensive hauling, will have to be worked out for the future.

Modified Itinerary Procedure.—The most noteworthy departure from the procedure of previous High Trip operations was the new practice of traveling a lesser total distance during the outing, with consequently fewer stopping places and considerably more time spent at each place. This schedule of short moves was dictated primarily by the terrain. Operating out of Mineral King for four weeks without a duplication of routes required either very short moves or very long ones, and the club's leaders decided on the former. It also helped the meadows.

Such a system could make it possible to cut down still further on the number of pack animals. The longer stop-overs allowed a further development of the shuttle service carried on last year wherein supplies are brought up from one camp to another by repeated use of the same pack animal. However, there is no saving in stock, unless the party be split, so long as there is a single long day somewhere on the itinerary that prevents a shuttle on that day, a situation that prevailed in both the two-week periods.

Not only does increased use of shuttle service allow further protection to the meadows through making use of fewer animals, it allows greater leisure and an increased opportunity to appreciate the high country by the club members. As examples of the new program's flexibility, and the optional side trips available, after leaving Mineral King, July 18, on the second two-week period, two full days were spent on Rattlesnake Creek, which permitted the members to make day-long explorations of nearby Little Claire Lake, Forester Lake, Great Western Divide at Shotgun Pass, and the forest and meadowland on the ridge north of Soda Creek.

Contrary to the original schedule and in order to reduce damage to the scanty forage supply, only one night was spent by the main party and its pack animals at Upper Funston Meadow. Even here the stock was turned out below the tourist pasture except for a few wranglers' horses needed to catch the rest. The balance of the time originally planned for Upper Funston was allotted variously: one string of mules with 25 people made a three-day side trip from Upper Funston to the summit of Mount Whitney, returning to the next base camp at Moraine Lake; another group of 25 remained at Upper Funston for several days with their belongings, but without pack stock, to do some fishing, and subsequently were transported to Moraine Lake with the assistance of a string of mules on shuttle service between the two camps. The main party moved directly to Moraine Lake from Upper Funston Meadow after the first night, adding the number of days originally scheduled for Upper Funston to the total that had been planned for Moraine Lake.

The long lay-over at Moraine Lake permitted still further dispersions of the main group: a party of eight made a three-day knapsack trip into the largely unknown and inaccessible Kaweah Basin; other groups climbed Mount Kaweah and explored Nine Lakes Basin. After the four-day lay-over at Moraine Lake, all these scattered forces again united and proceeded to Lost Canyon, where another lay-over of two full days was made, enabling various parties to explore Big Five Lakes Basin, Columbine Lake, and the region around Needham Mountain.

Problems in the Long Lay-Over.—On the other hand, the law of diminishing efficiency again begins to operate as the length of time between moves is increased. The fish population suffers more, the campsite becomes trampled and more denuded of wood supplies, bigger pits must be dug for waste, and meadows are grazed more heavily by nonworking stock that has caught up with the business of moving supplies. The number of workable itineraries in the Sierra becomes severely reduced since there are relatively few places that can be used for really extended stays without damage. This means that the workable ones would have to be used more often.

Resistance on the part of the mountain traveler also would commence to operate, possibly leading to a decreased enrollment and operating losses. The people who elect to go on the present type of High Trip (instead of the sedentary spot-camp trip) begin to tire of staying in one place if the stop-overs extend beyond a maximum of about three nights. A stay of that extent provides one day to come into the area from one direction, one day each for trips to two lateral points, and the morning of the fourth day for leaving by a different direction.

Effect of Trip on Meadows.—The itinerary of the 1949 High Trip was shifted from Yosemite at a late date, and with great effort, in order to avoid overgrazing of the mountain meadows there. With the exception of Upper Funston Meadow in Kern Canyon, stopping places were in more or less out-of-the-way areas where forage was relatively abundant and grazing by other parties light. At Upper Funston Meadow, the schedule was changed during the trip so that the limited forage there would be used for only one night.

To enumerate specifically, on Rattlesnake Creek the camp was near the upper end of the canyon and the stock was pushed uphill into a basin similar to Granite Basin, but smaller, near Shotgun Pass. Some of the stock strayed from this area back down to various meadows on Rattlesnake Creek, but no appreciable damage occurred. This side-trail basin receives very little use from other parties traveling through Rattlesnake Canyon. At Moraine Lake the stock was turned loose in Sky Parlor Meadow, which is one of the largest meadows in the Sequoia and Kings Canyon National Parks. It was not harmed visibly by this use. In Lost Canyon, which receives hardly any use by other visitors, camp was near the upper end at timber line, and the stock was pastured in the excellent, healthy meadows downstream from that point.

Voluntary Restrictions on Fishing.—The Sierra Club's effort to conserve the natural resources of the Sierra was typified by the fishing program. The fishing members of the club held a meeting on July 19 to outline policies for the present outing. After taking a vote, they decided to restrict themselves to three fish per fisherman per day on Rattlesnake Creek, and to five fish per fisherman daily on all other streams in that region. It was agreed that only in the lakes would the regular legal limit of fifteen fish be observed. There were two reasons for making this exception with respect to the lakes: (*a*) In some of these lakes it had been found that the fish had

large heads and small, thin bodies, indicating an overabundance of mutually competitive individuals; (*b*) It was felt that the difficulties of lake fishing were such that there would be no danger of depleting such areas.

It was also agreed that whenever camp was moved to a new fishing area, overall fishery conditions would be sampled by the first fishermen to arrive, and that on the following morning another meeting would be held to determine whether any change should be made in the self-imposed limits mentioned above. A daily creel census also was conducted, with each fisherman reporting his catch at campfire.

Camp Cleanup.—The Sierra Club's tradition of leaving its camp sites cleaner than they were found has been stressed for years, and was discussed at some length during the High Sierra Wilderness Conference last April. As the photographs show, after the garbage has been burned and all tin cans smashed flat and buried, members even carry in loads of pine cones and duff to obliterate further the marks of use.

Suggestions.—In general the 1949 system of itineraries, which embodied a smaller number of stopping places than in previous years, with longer stop-overs between, might well be continued in the future. This system not only helps reduce the number of pack animals but permits a more leisurely enjoyment of the mountains. Those who like to hurry from place to place and climb a great number of peaks can still do so from the camps; others may enjoy the scenery in a more relaxed manner.

Probably most of the members, if polled, would vote for camp-to-camp moves intermediate in length between the 1949 short trips and the longer ones of 1948. This would seem to involve trips in which each move would not exceed seven miles. Under such a procedure the pack stock on moving day could bring up two loads on shuttle service: commissary equipment on the first load and dunnage bags on the second. The stock thus would travel 21 miles that day to seven miles by the members. Some consideration also has been given to an alternative system under which possible itineraries could be multiplied through moving to the next distant camp in two sections, splitting commissary and guests. Such a splitting of the group would involve new problems in administration and logistics.

However, if it could be worked out, the mule-man ratio could be cut almost in half, with a corresponding cut in the cost of the trip that would probably enable more people to afford it. Or if some intermediate reduction in animals can be worked out, it may permit regular allocation of a substantial amount of money for additional hay and hay hauling. The club's only recent experience in the comparative costs of mule vs. helicopter was in arranging to have materials transported to the Benson Hut site on Mount Anderson, at an elevation of about 8,000 feet. The helicopter estimate was about twice as high as that for mules, so the latter were used and the club was spared having to think about the implications of helicopters.

It has been traditional that the Sierra Club's High Trip commence on July 4 and extend for a month, although divided into two two-week sections. This early date for commencing the outing appears to have been dictated largely by the wish of the packers to have the Sierra Club outing come at a different time from the main tourist travel season. However, the use of mountain meadows by large numbers of stock results in a greatly increased impact early in the season. It is hoped that the dates of the High Trip for next year can be retarded so that the trip falls in July and August instead of wholly in July. If this can be accomplished, more benefit will result than from almost any other single remedial measure.

GLACIERS THEN AND NOW

By A. E. Harrison

Even the earliest of the observers of our Sierra glaciers were concerned with their rate of shrinkage. I. C. Russell wrote in 1883 (1),* "That this noonday melting has more than counterbalanced the annual additions which the glacier has received during the last few years seems evident from the accounts we have of the previous extent of the snowfields of the high sierra." Russell was referring to accounts by Joseph LeConte and John Muir of their observations of the Lyell Glacier in 1872 (2, 3).

G. K. Gilbert, who accompanied Russell during his exploration of the Sierra glaciers in 1883, returned on August 7, 1903, to photograph Mounts Lyell and Maclure. He emphasized the need for glacier data and photographs in an article in the 1904 *Sierra Club Bulletin* (4). He did not point out any radical changes in the Lyell Glacier but made comments on the retreat of the Maclure Glacier which are considered in following paragraphs.

The unusual recession of the Lyell Glacier in 1919 was noted and photographed by Francis P. Farquhar (5). Now, with several severe dry spells behind us, we can really indulge in the comment, "They hadn't seen anything yet!"

An opportunity to observe the Sierra glaciers during the summer of 1949 and compare the present extent of the glaciers with the older photographs and observations was welcomed as an ideal vacation. The preceding winter of 1948–49 had been exceptionally cold and the snowfall at the higher elevations of the Sierra had been very light. This combination of circumstances is not surprising; the region of maximum precipitation is likely to occur at lower elevations during an extremely cold season. At any rate, conditions were ideal for observing the glaciers because the surface snow had melted, exposing the ice beneath.

A preliminary trip to the Dana Glacier with a National Park ranger-naturalist party on August 4, 1949, served as the introduction for an intensive ten-day trip, beginning on the Labor Day week end. In the course of this time we made photographs of the glaciers on Dana, Conness, North Peak, Lyell, Maclure, Kuna, and Koip Peak (Parker Creek Glacier). When possible, photographs were taken from the exact position used by earlier observers. A copy of the picture of the Dana Glacier taken by Russell in 1883 and Gilbert's photographs of Lyell and Maclure in 1903 are included for comparison with the 1949 photographs.

Most of the recorded data on these glaciers can be correlated with Weldon Heald's study of climatic cycles published in the 1949 *Bulletin* (6). The summer of 1883 followed an unusually dry winter during a period of less than average snowfall. Gilbert's photo of August 7, 1903, depicts conditions in a year of average snowfall following a period of exceptional precipitation. It is even possible that the Lyell Glacier may have increased in thickness in the period between 1890 and 1900. Certainly there is little likelihood that any great recession occurred at this time.

At the time of Farquhar's photograph in 1919 the beginning of the dry period was having its effect, and the ice has continued its recession at an increasing rate since that time. The icefall between the west and east lobes of the Lyell Glacier (see

* See references at end of article.

Gilbert's photo in 1903) disappeared in the decade after 1921. The icefall appears in an unpublished photograph by Joseph N. LeConte taken July 4, 1921, but is missing in Ansel Adams's telephoto view from Mount Dana in 1931 (7).

In spite of the increased snowfall between 1932 and 1937, the Lyell Glacier continued to shrink. Photographs I took on September 5, 1937, indicate that the ice in the vicinity of the icefall had decreased in thickness considerably. This decrease is evident in the chimney formerly occupied by the icefall, and is also indicated by the fact that a rock shoulder extending out into the east lobe above the chimney was exposed in 1937. In Ansel Adams's telephoto view of 1931, the position of this shoulder appears as a gray spot, like debris on the surface of the glacier.

Other evidence of the loss of ice is given by the retreat of the east lobe of the glacier from its moraine. Apparently this retreat began in the early thirties, but from an inspection of Adams's photograph it is difficult to be positive that the ice had begun its retreat as early as 1931. The National Park Service began its glacier surveys in 1931 and its records might clear up this point. In 1937, several patches of bare rock existed between the glacier and the moraine. By 1949 these patches of bare rock had developed into a continuous area, as indicated on my photographs of Mount Lyell, particularly the view from Koip Peak on September 12, 1949.

In view of the long history of glacial decline, it is quite amazing to discover anomalous instances of glacial growth. For example the rock shoulder mentioned above, which in 1937 extended out into the east lobe of Lyell Glacier, is now covered with ice. The ice also fills the chimney to a greater height. These observations were checked by comparing photographs taken from the same spot in 1937 and 1949. The height of Mount Lyell above the glacier was used as a standard of measurement, since the photographs indicated no appreciable change in the ice directly below the peak. The height of the rock to the left of the chimney was then determined in both photographs. The ice was sufficiently higher on September 8, 1949, to explain the disappearance of the rock shoulder observed in 1937, in spite of the fact that there was snow on the surface of the glacier in 1937. There is little doubt that this particular area received more snow during a period when the snowfall was below normal and most of the glacier was dwindling rapidly.

It is also interesting to note that in 1937 a large snowbank lay between the lateral moraine of the Lyell Glacier and the east slope of Mount Maclure. This snowbank was not present in Adams's telephoto view of 1931 and had disappeared again in 1949, although a narrow strip of stagnant ice remained in the gully between the moraine and Mount Maclure.

This rather detailed account of the changes in the Lyell Glacier is useful in relation to the other glaciers because it explains apparent discrepancies in some of the earlier observations. Probably the most significant point is that there has not been any general retreat of the glaciers from their moraines until the last two decades. Until recent years, the glaciers have become thinner but the ice has remained continuous with the stagnant ice under the moraines. It is unlikely that there has been any frontal advance since the last glacial maximum about 1850 (8), although the ice may have increased in thickness in years of exceptional snowfall.

These conclusions help to explain Russell's belief that the Lyell Glacier was dwindling rapidly in 1883. John Muir (3) had reported the length of the Lyell Glacier as "about one mile." Joseph LeConte described the glacier as one half mile in width

and a mile long, although his rough sketch of the west lobe (2) indicated an almost circular shape. These observations may have led Russell to conclude that in 1872 the glacier extended beyond the present moraine system. It is now apparent that the glacier did not retreat between 1872 and 1883 and that the earlier estimate of the length was inaccurate. The most reliable data regarding the extent of the Lyell Glacier at that time are furnished by the description of the terminal moraine. LeConte described the moraine as 20 feet in height and 50 feet in width at the base. Since the present moraine is larger, we can guess that the glacier occupied space which is now covered by moraine, although it is possible that a more extensive moraine was hidden by snow in 1872.

The report by W. D. Johnson, who made the map for Russell's article in 1883 (1), that the Maclure Glacier extended as a wall of ice out into the lake can also be cleared up by the observations during 1949. Gilbert had questioned Johnson's map after photographing Mount Maclure in 1903 (4), but after correspondence with Johnson accepted the possibility that the glacier has retreated from the lake. It is now apparent that the moraine in the August 7, 1903, and September 9, 1949, photographs represents the maximum advance of the Maclure Glacier. The ice body which Johnson observed was stagnant ice separated from the glacier by the rock shoulder between the lake and the moraine. During the summer of 1949 this ice could not be mistaken as a snowbank because all snow had melted, even from the surface of the glaciers, and the true nature of the stagnant ice bodies was revealed.

Confusion of stagnant ice with true glaciers is much easier to eliminate now that the patterns of moraines have been sharply defined by the retreating glaciers. For example, on the Dana Glacier one can distinguish a lateral moraine in the photograph taken August 4, 1949, which is connected to the upper end of the terminal moraine and extends toward the cliffs on the left of the ice chute. The *bergschrund* now ends at the rocks east of the chute, indicating that the ice to the left of this point has no motion. Although Russell's picture in 1883 shows the *bergschrund* extending somewhat farther to the left than at present, it is apparent from the moraine that most of the ice filling the end of the canyon was motionless even during the period of greatest glacial activity. Two rock slides have now covered much of this stagnant ice with talus, but the old ice can be found beneath the rocks.

Another example in which large masses of ice lack sufficient depth to provide glacial motion is found at the Parker Creek Glacier, photographed on September 12, 1949. This ice was considered a part of the glacier when this region was mapped by Johnson in 1883 and again by the United States Geological Survey in 1898. All this ice appeared to be continuous with the Parker Creek Glacier in a photograph from Mount Dana taken during the summer of 1937. Recent melting has divided the ice into three separate parts.

Other small glaciers have been incorrectly assumed to be old snowbanks when actually they are still active. A number of little glaciers east of Mount Lyell were mapped by Johnson in 1883 and are visible in the photograph from Koip Peak. These are not shown as glaciers on the Mount Lyell topographic map. An excellent view of the nearest one, which has a well-formed moraine, can be obtained from the summit of Mount Lyell. A small glacier, unmapped by either Johnson or the United States Geological Survey, was discovered on North Peak near Mount Conness. Its moraine is clearly visible but the crevasses which we observed in the ice

are not apparent in the photograph taken September 6, 1949. A small lake below the glacier has a trace of the milky tinge characteristic of glacial lakes. The activity of this particular glacier is extremely small and it is probably on the verge of becoming stagnant.

Mount Conness Glacier poses one of the most interesting problems because it was once the most active glacier in this region but is now disappearing most rapidly. Its moraine is simple in structure and does not have the multiplicity of crests found on the moraines of other glaciers in this region. It is very high, indicating a former ice thickness of several hundred feet (8). However, the ice retreated from the moraine of the east lobe some time ago and it is now retreating from the western moraine.

In contrast with the Conness Glacier, the Koip Glacier represents a very complex moraine structure. At least six crests and possibly seven are visible on the moraine under Koip Peak, and the number of crests in the foreground could not be counted. This glacier and the canyon which it occupies provide one of the best examples of ice sculpture and moraine building in the entire region. Like the Dana Glacier, it has a number of well-preserved older moraines in the canyon below.

Although the Koip Glacier is well known to the National Park rangers, it is seldom visited by hikers because it is hidden from view along the Parker Pass Trail. It was not shown on Johnson's map and is indicated incorrectly as a very small glacier on the Mount Lyell topographic sheet. Anyone who cares to search for it will be rewarded if he turns right at the first stream after leaving the Park boundary at Parker Pass and follows this stream to its source. Circle well around the right of the moraine before climbing it or you will find yourself among a sea of boulders. Koip Glacier is visible from the top of Mount Dana, and probably an even better view including the entire moraine can be obtained from the summit of Mount Gibbs.

Aside from the pleasure of exploring the mountains, one can learn a great deal about the world we live in from a study of the present and past behavior of the glaciers. Our brief vacation left us with a renewed respect for the problem. The number of new, unanswered questions far exceeded the number we could answer. The amount of information divulged by the glaciers is tremendous, far more than a single party can gather in a few weeks of a single year. The fascination of the problem is irresistible and we are anxious to return at the first opportunity.

REFERENCES

1. I. C. Russell, "Existing Glaciers of the United States," *U. S. Geological Survey*, 5th Annual Report, 1883-84, pp. 309-355.

2. Joseph LeConte, "Ancient Glaciers of the Sierras," *American Journal of Science and Arts*, Third Series, Vol. 5 (Vol. 105), pp. 325-342, 1873.

3. John Muir, "Actual Glaciers in California," *American Journal of Science and Arts*, Third Series, Vol. 5 (Vol. 105), pp. 69-71, 1873.

4. G. K. Gilbert, "Variations of Sierra Glaciers," *SCB*, 5:20-25.

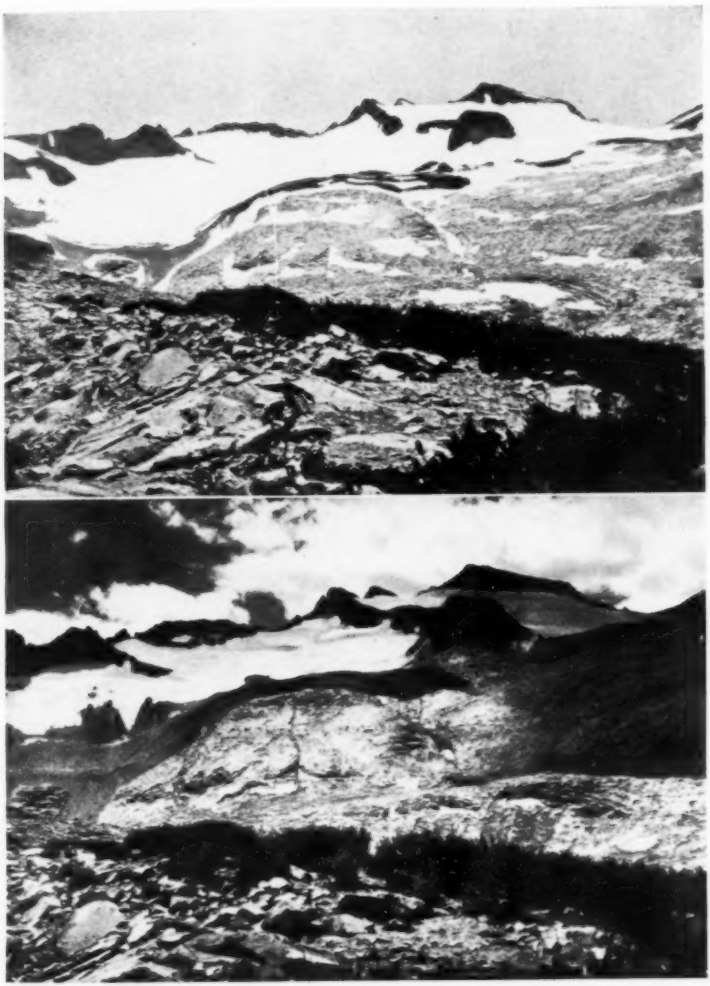
5. Francis P. Farquhar, photograph of Lyell Glacier, *SCB*, 11, p. 49.

6. Weldon F. Heald, "Sierra Snows, Past and Future," *SCB*, 34, pp. 55-67.

7. Ansel Adams, telephoto view of Mount Lyell from Mount Dana, *SCB*, 17, p. 22.

8. François E. Matthes, "Moraines with Ice Cores in the Sierra Nevada," *SCB*, 33, pp. 87-96.

Glaciers Then and Now

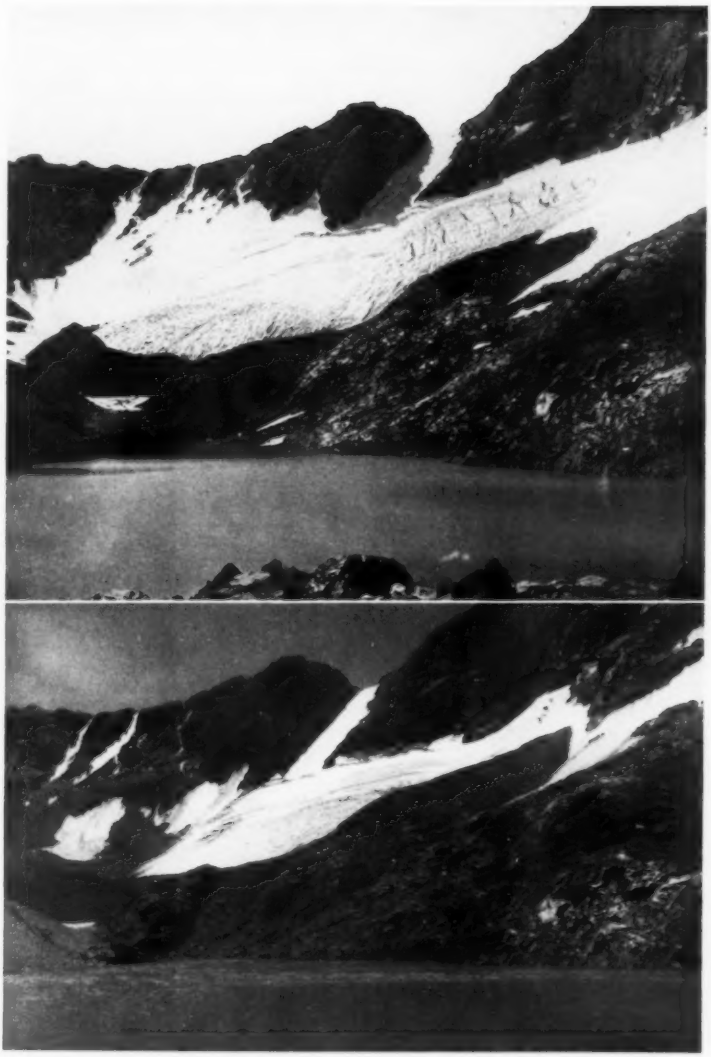


(Above) Lyell Glacier on August 7, 1903. G. K. Gilbert took this photograph from the north end of a low ridge between the two branches of the Lyell Fork. The spot was marked with a cairn which is almost hidden by trees.

(Below) Lyell Glacier as it appeared on September 8, 1940, taken from the same spot used by Gilbert in 1903. Only the glacier has changed; the trees in the foreground seem no different after a lapse of forty-six years. The old stump in Gilbert's photograph is still there but only the tip of it appears. By A. E. Harrison.

(Above) Dana Glacier in 1883. (I. C. Russell photograph, courtesy U. S. Geological Survey.) The bergschrund extends farther to the left than at present, although much of the ice at each end of the glacier was stagnant at that time. The glacier appears to be almost overriding the moraine at several places.

(Below) Dana Glacier on August 4, 1949, from the north side of the old moraine forming the dam for the lake in the foreground. Talus has covered most of the stagnant ice at the left of the glacier. There was very little snow on the surface of the glacier even at this early date. By A. E. Harrison.



(Above) Maclure Glacier on August 7, 1903. Photograph by G. K. Gilbert.

(Below) Maclure Glacier on September 9, 1949. The exact spot used by Gilbert was not found, but this view is apparently from the same vicinity. Note the well-developed bergschrund and crevasses in the glacier, also the patch of ice in back of the lake. By A. E. Harrison.

(Above) Parker Creek Glacier on Koip Peak, September 12, 1949. The bergschrund in this case in a series of transverse crevasses. The three ice bodies in front of the glacier are stagnant and probably were motionless even during the glacial maximum. The left portion of the glacier is also stagnant, since there is no moraine below this portion and it does not appear to be excavating a cirque cliff. The small ice patch beyond the glacier may have motion as there is a well-formed cliff above it. Photographed from the trail at the top of the zigzags on Parker Peak.

(Below) Koip Peak, Kuna Peak, and Koip Glacier on September 11, 1949, from the east end of a 12,500-foot peak of red rock which appears to be conical from the glacier. A second cairn was constructed to mark the camera location, which was slightly below the highest point. Photographs by A. E. Harrison.

DAMS AND THE LAND

(Followng are extracts from a paper by Gerard H. Matthes, Honorary Member, American Society of Civil Engineers, entitled "Solids in Stream Flow," which appeared in Transactions of the American Geophysical Union, June, 1949.)

THE WISH, so often expressed by nature lovers and over-solicitous conservationists, to the effect that soil wash from the land should be prevented to the extent that streams may flow clear water at all times, is not founded on sound doctrine. A certain amount of sediment is needed by streams to maintain their channels. The amount of sediment load so required varies widely as between streams, depending upon watershed conditions and climate, and is undefinable except as it may be designated by the term "natural load." Usually largest in proportion to water discharge during high stages, the natural load may dwindle to zero during extreme low stages, and may even become a negative quantity when silt and fine sand are blown out of dry river beds, a common occurrence in western stream beds. But, whatever characteristics the natural load may assume in individual cases, its function is indispensable as a stabilizing agency in the maintenance of natural channels. In the absence of this natural load, as for instance where sedimentation in a large reservoir robs a stream of its load, the desilted waters issuing from the reservoir build up a new load by eroding the stream bed. Conversely, excessive soil erosion, that is, erosion in excess of natural rates, operates to overload streams. In either case, stream channel deterioration ensues, usually followed by a sequence of ruinous conditions which are extremely costly to rectify and in many instances are not correctable. . . .

Retrogression and Aggradation Below Dams.—In Europe and also in British India, Engineers early made acquaintance with river-bed retrogression below dams due to interception of the sediment load, and learned the dangers of this long before the subject evoked interest in this country. In practically all cases where bed retrogression reached large proportions, aggrading of the river bed farther downstream caused by coarse bed-load materials dumped in by the tributaries, has been the more serious evil. The concurrent action of retrogression and aggradation amount to a leveling process that flattens hydraulic gradients. Once such conditions reach an advanced state, the channel is damaged usually beyond repair.

In this country, the case of the Rio Grande below Elephant Butte Dam is one of the earliest, and is therefore well known. Only its salient features need be mentioned. Aggrading of the bed, caused by gravel brought in by several uncontrolled tributaries which empty into the river below the dam, was the primary cause of profile flattening. Storage of flood flow by the dam deprived the river of its erstwhile power to erode and transport these sediment accretions. By contrast, erosion of the bed below the dam has been but a minor contributing factor. It was checked by four low diversion dams for irrigation, and to some extent also by the gravel brought in by the tributaries. Aggradation of the river extending downstream to El Paso reached its maximum at the International Dam, and thence continued downstream for some distance. Rapidly mounting damage caused by flash floods from the uncontrolled tributaries referred to, made necessary the construction of Caballo Dam, 30 miles downstream from Elephant Butte. This high dam now effectively controls the floods from these tributaries, and by checking further aggradation has made possible an extensive rectification of the channel below El Paso. These works, all built at great cost, have restored fairly stabilized conditions. Obviously, no small-

scale local effort could have remedied the untenable conditions that were created by the channel deterioration.

An entirely different situation has developed on the Colorado River below Hoover Dam since its closure in 1935. The scouring power of the clear water, released on a river-bed slope of 1.5 to two feet per mile, caused extensive erosion. The finer particles were transported great distances down the river, but the coarser materials settled out sooner. In the vicinity of Needles, California, about 100 miles below the dam, aggradation previously had been in progress for many years from natural causes, the rise of the bed amounting to 11 feet in the period 1902–1935. This aggradation became accentuated when, in November of 1938, the backwater from Parker Dam reached the vicinity of Topock, 12 miles below Needles. Bars formed in this backwater which gave rise to dense growths of willows and tules which in turn invited further deposits. Since that time the river bed in the Needles-Topock stretch has built up at an average rate of 1½ feet a year, thereby causing the low-water surface in the river to rise higher than the bank on each side. This process extended upstream at a rapid rate, gradually obliterating the regular course of the river. A dense jungle-like area 12 miles in length and from 1½ to as much as five miles in width now exists in the vicinity of Needles. Aerial photographs reveal a maze of small channels but no main channel. Vegetation has been the dominant factor. It has served to build up with sediment the central part of the so-called swamp at least four feet higher than the sloughs which exist along the two banks. These sloughs contain clear water that has filtered through from the central part of the swamp, all sediment down to the finest particles being screened out by the close-growing tules. In 1941 when Lake Mead filled to a height requiring release of more water than was regularly being released to meet the demands of water users, a serious inundation took place at Needles and an unsatisfactory sanitary condition developed. Up till the end of 1943, inundation at Needles, even during regular water releases from Lake Mead, became progressively worse. The "Needles Swamp" is a case of channel obliteration, exceeded in magnitude only by that of the White Nile in Africa, where that river becomes lost in the papyrus swamp of the Sudd. As in the latter case, the losses of water in the Needles Swamp by transpiration from plant surfaces and by evaporation from water surfaces are enormous. Present plans contemplate the excavation of an artificial channel the full length of the swamp with discharge capacity sufficient to carry flows appreciably greater than the regular water users' demands, without raising water levels to damaging heights (Bureau of Reclamation, 1947). . . .

The Sacramento River Case.—What doubtless ranks as the most remarkable chapter in the annals of river reconditioning in this country, is the rehabilitation of the Sacramento River, California, after its bed had become clogged with placer mining debris over a period of more than 30 years. Cessation of debris dumping, inaugurated in 1884, has enabled the river channels affected to clear themselves. Their competence and capacity in the matter of transporting the accumulated debris has been nothing short of astounding. About 1890 aggrading of the river bed had raised low-water level on the gage at Sacramento, 10.5 feet and as much as 20 feet in the mouths of the principal tributaries. About 1897 a steady bed lowering was noticed which culminated in 1920 when low water at Sacramento gage again registered 0.0 (mean sea level). Since that time the Sacramento River has resumed its

normal functioning. Its main tributaries, however, required ten more years to return to normal.

The next chapter in this river drama is about to unfold itself. Since 1930 the transporting capacity of the main river has been more than equal to evacuating the remaining debris still coming down from points far up in the watershed, attributable probably to overly effective interception of mining debris plus natural bedload in the tributaries. With the completion of Shasta Dam on the main river, retention of additional bedload materials now is likely to complicate further the situation. Engineering skill is girding itself in this case to the task of combating impending channel deterioration on a scale hitherto untried.

Useful examples of what can be accomplished in the way of desilting water diverted for power or irrigation uses, including the return of the intercepted silt to the rivers, are found above Columbus, Nebraska. Three developments there utilize the waters of the North Platte, Platte, and Loup Rivers, all notorious sediment carriers with concentrations ranging from 500 ppm during low stages to 20,000 ppm during flood flows. Because adequate works for handling silt were provided, the operation costs of these works have been quite low (anonymous, 1936; Boughton, 1939).

Conclusion.—The increasing tempo of surface-water utilization and flood control which are being witnessed in North America, is destined to bring with it widespread problems resulting, directly or indirectly, from stream-channel deterioration. Shrinking channel capacities appear to be next in order as the potential source of a new flood menace. The consequent economic damage will be the greater, the longer the day is deferred to give this situation intelligent consideration. Valuable as are the lessons taught by what happened on the Sacramento River, on the Colorado River, and on the Rio Grande, these lessons are not being heeded sufficiently. Western and mid-western streams are likely to be affected most. Although, possibly, in New England, there is least to fear in this connection, because so many of its streams are small and flow in fairly permanent beds, yet there is good reason to believe that its larger rivers are not immune to retrogression or aggradation.

Broadly viewed, unless this country approaches its surface-water utilization, flood-reduction and sediment-control problems with more foresight, future generations may well find themselves confronted with reservoirs filled with sediment, and below them puny, badly deteriorated stream channels, wholly unfit to resume the task of carrying the water and sediment discharges which, formerly, they were fitted by Nature to carry.

Mountaineering Notes

Edited by Morgan Harris

Climbing in the Selkirks

The Selkirk Mountains, lying inside the bend of the Columbia River, and to the north and west of the Purcell Range, are one of the more heavily glaciated portions of the interior ranges of British Columbia and offer to the mountaineer a wide variety in snow and ice climbing. During the summer of 1949 Jack Hanson, Dave Nelson and Joe Firey visited this region with designs on Mount Dawson, the highest peak in the range south of the railroad.

Tuesday, July 12, found us backpacking to a camp at the upper end of the Asulkan Valley. On the following morning we ascended to Asulkan Pass where we had a superb view of Dawson lying to the south and across the valley of the Incommapleux River. During the afternoon we climbed Leda and Pollux, the first two pinnacles on Asulkan Ridge leading to the north and west from the pass.

The next day we crossed Asulkan Pass and descended into the profound gorge of the Incommapleux. Palmer in the early 1900's crossed the Geikie Glacier at the foot of the Asulkan Pass. But today the glacier has receded approximately a mile upstream on the Incommapleux. Because of the difficulty of a river crossing we ascended along the river bank to the snout of the Geikie Glacier. From here it could be seen that the Geikie Glacier has become severed from the Illecillewaet Nevé. The lower ice block, about a mile in length, is evidently deteriorating rapidly in the absence of a substantial supply of ice. Continuing on we crossed the shoulder of Mount Fox and made camp in Dawson Valley.

In the Selkirks a stretch of good weather such as we had experienced arouses suspicions of foul weather to come. Accordingly an attempt on Dawson was planned without delay. We left Dawson camp at 4:00 a.m. on July 15, cold and somewhat befuddled. The left marginal moraine provided a means of ascent to the upper reaches of Dawson Glacier. After a brief foray into the center of the glacier we passed beneath the north wall of Dawson skirting mountains of avalanche snow and ice. Shortly thereafter the source of this material was spectacularly revealed to us when a large block of ice peeled off a hanging glacier high on the north face of Dawson.

The headwall of Dawson cirque is best climbed to the left to avoid remaining beneath the many pendant ice masses. The ascent here is made over rotten, slippery shale with an entirely unfavorable slope of stratification. Though technically simple the climb required care. The Dawson–Fox col was reached shortly after noon and a halt made for refueling.

After lunch the ascent continued up a slippery shale finger of progressively increasing slope. Farther up we took to the snow on the upper ice fields of Dawson Glacier. A foot of fresh snow lay over all and made slow going since the location of crevasses was almost impossible to ascertain. The weather had held good to this point but as we came up on Dawson Ridge below the summit it became quite clear that a prompt change was in the offing. We reached the ridge in the midst of a thunderstorm with spectacular but unappreciated displays at close range.

After the first wave passed we promptly assaulted the summit pitch. A small but adequate schrund blocked the path with evident avalanche conditions near a bridge on the right. The far left end, perched airily on a cornice overlooking the south face of Dawson, looked possible. With crossed fingers a long step was made into soft and clearly unreliable snow, and the schrund was passed. A short but steep ascent over firm snow and rock brought us to the summit ridge just as the second thunderstorm arrived with accompanying electrical discharges. We made a rapid retreat to a shallow cave below the summit. Although the storm gave signs of continuing for some time the lightning ceased shortly and the descent was commenced in worsening weather. An alternate route to the Dawson cirque headwall was found, passing over the south shoulder of Mount Fox and thence back onto the Dawson Glacier over steep snow slopes. This route proved practical and was relatively free of rotten shale found along the headwall route. Camp was reached at dusk in heavy and steady rain.

Continued bad weather forced us to return to Glacier Station. On July 19 we left to commence the long drive back to California.

To those mountaineers seeking a variety of snow, ice and rock climbing combined with spectacularly scenic surroundings, the Selkirks have much to offer. The major drawbacks to this area are the substantial absence of trails to the major climbing areas and the characteristically unreliable weather. This latter difficulty does not appear to be peculiar to the Selkirks. J. C. Firey

The Bugaboos—1949

Ruth and I had long been entranced by accounts of the sound rock and unsound weather in this famous region, so August found us at Bugaboo Forks, moving up to Boulder Camp beneath overcast skies.

A golden sunrise found us crossing the covered glacier below Snowpatch, bound for Bugaboo Spire. As the south ridge fell beneath us, a sharp watch of the west face ledges below the Big Gendarme revealed no evidence of the tragedy that claimed the lives of Sierrans Rolf Pundt and Bob Becker in 1948. Despite the easy climbing the writer developed a bad case of the "Messerschmitt Twitches"—every thirty seconds he glanced over his shoulder at the clouds now scudding across from Howser Spire. From the summit the northwest peak looked close, but the gloomy weather made the intervening ridge look uninviting as the only possible retreat, so we descended to camp.

After two days of snow, rain, and lightning came the long but beautiful trek across the Warren Glacier to Pigeon Spire. The storm had plastered the mountain with ice and snow; after easy but careful climbing in glorious weather, the summit was reached. The view beggars description, and we can but hope that many others will share it. The Howser Spires had far more snow than normal, as indicated by photographs, and seemed to be an unwise undertaking; accordingly, we went no closer.

The west base of Bugaboo Spire was studied from the Warren Glacier, but no evidence of the accident was visible. Returning across the snow-laden glacier north of Snowpatch did not seem to require "sounding" for crevasses, since that had been done upon the three previous crossings by the same route. As usual, two Prusiks were knotted on the rope and thrust into my waist loop. I had just remarked to Ruth that many good climbers would think it queer to wear a rope there—and promptly went waist deep into a hidden crevasse. Ruth followed suit a bit later.

Two persons alone on a covered glacier, two weeks from aid, must observe suitable precautions.

Our final climb, an ascent of the Bugaboo Icefall, was by far the most interesting. I particularly remember ascending the walls of a crevasse, using crampons in a chimney technique above the mysterious blackness; then cutting handholds in a tiny, merry glacier waterfall. So ended our enjoyable stay in this inspiring, beautiful region.

JOHN D. MENDENHALL

CANADIAN ASCENT—1948

Early in the spring of 1948 Charles and Ellen Wilts, Ray Van Aken, and I had looked through the journals and travel folders and had studied over the Canadian maps. Finally we settled on a schedule calling for one jaunt into an area north of Mount Diadem and a second jaunt out onto the Columbia Icefield for an attempt on 12,294-foot Mount Columbia, the second highest in the Canadian Rockies.

The area to the north of Mount Diadem and lying between the Athabaska and the Sunwapta rivers attracted our attention because there seemed to be considerable unexplored terrain here with several unclimbed and unnamed peaks in their midst. The usual route to adjacent areas, we found from the literature, consisted of a trek up the Athabaska Valley and thence up creeks draining the high basins. However, we concluded from examination of the topographic sheet that it might be feasible to cross the Sunwapta River and approach the area directly up one of several canyons.

Hence, on the afternoon of the 29th of July we left our car just above Mile 53 and forded the multi-branched Sunwapta River. This was done without great difficulty and was somewhat enlivened by one member who made an impromptu glissade backwards down a clay bank into the drink, pack and all! We had examined with glasses two canyons and both seemed rather forbidding in their upper reaches due to the presence of formidable rock and ice cliffs. We chose the southernmost of the two and started bushwhacking. The timber, although not large in diameter, was very dense and many windfalls were encountered; the use of worn game trails was an occasional boon. We pitched a late camp.

It was not until the afternoon of the second day, as we approached the headwalls of the cliffs, that we spotted a possible route out of the canyon by a broad, northerly gully and a series of ledges. Early the following morning Charlie, Ellen, and I left Ray, who was temporarily down with gastritis, to reconnoiter the area above.

To reach the icefield we ascended the gully and a series of ledges to the north, then veered west onto the ice. Here we were met by an awesome view of the ice-covered northeast face of Mount Diadem. The three of us also had a chance to look at our objective, an unclimbed peak of good size a mile or so away.

To gain the col between Diadem and our peak, we ascended a nevé slope which approached vertically near its head. The rope was uncoiled for the last pitch and I had fun cutting deep hand holes and foot steps for the last twenty feet of 80 degree snow and ice. Charlie and Ellen hurried up the pitch to share a terrific view of Mount Alberta only a few miles away.

A series of shale-covered ledges took us up the south face of a subpeak whence we traversed to the west face of the main peak. More scrambling and a few easy fourth-class pitches brought us to the summit at 4 P.M. Views down in all other directions quickly convinced us we had chosen by far the easiest route.

Charlie busied himself with a Brunton pocket transit and by triangulating on Mount Diadem and Mount Alberta found this peak to be 10,500 feet. Several other peaks in the vicinity appeared to offer interesting climbing problems. We descended without incident and enjoyed quite a glissade down from the col. Thirteen hours after starting we returned to camp and to a pot of tea readied by Ray, who was feeling quite well by this time. After a council of war, we decided we were too far from the other peaks at our present camp. The next morning we regretfully broke camp and headed for the Sunwapta River and our car.

Several days later we ascended the nose of the Athabaska Glacier, making our first camp at the hut located on a ledge just south of the second icefall. The great icecliff of Snow Dome overhanging the north walls of the glacier provided us with an evening sideshow as great chunks broke off and roared down to the mother glacier.

The next morning, August 4th, took us amidst great crevasses up to the Columbia Icefield and out onto its 125 square miles of rolling nevé and ice. By 10 A.M. we noted a great, black bank of clouds to the west, which must have at that time been approaching or covering the Bugaboos. At noon we saw we were in for some bad weather, but we pushed on until Mount Columbia came into view. As the storm rushed over the next range to the west, we started to pitch camp, but it caught us with our poles down. To the accompaniment of rain, lightning, thunder, and snow we scrambled inside and dragged our gear after us. For two days it snowed continously and we had to dig out the walls around the tent several times to keep the drifts from pushing our shelters in on us. On the third day we decided to break camp in spite of continuing snow and zero visibility and to plot our way out by compass. This proved to be difficult and was complicated by the presence of the magnetic elements in our light meters! We traveled at rope-length apart and all fell into the snow-bridged crevasses in spite of careful probing. Fortunately our packs always jammed at the top.

We crossed what we believed to be the col marking the edge of the icefield and the start of the glacier, but the terrain didn't seem just right. After threading our way through more crevasses we descended far enough out of the dense cloud which had hugged the icefield to be able to catch an occasional glimpse of our surroundings. We were not on the Athabaska Glacier, but had missed it and were now on the Saskatchewan Glacier! There was no intention of going back onto the icefield, so we proceeded down this, the longest valley glacier in the Rockies, and eventually to the highway.

As the weather persisted in remaining unsettled we eventually headed southward with vows to return another year to these beautiful Alpine-like Rockies.

GEORGE HARR

THUNDERBOLT PEAK

The recent elevation of this summit into the ranks of the fourteen-thousanders will undoubtedly cause many climbers to look upon Thunderbolt with renewed interest. It is desirable, therefore, to point out that climbers attempting to follow the present guide from the Dusy-Palisade Basin side of the crest may experience the same difficulties we had last summer.

On September 3, 1949, Sylvia Kershaw, Mildred Jentsch, Hunter and Isabella Morrison and I started from Dusy Basin. On the summit of the Palisade-Dusy Basin

divide our compass indicated that the main crest was due north. We took the first feasible chute on the Dusy Basin side of the divide. This narrow chute has very high vertical walls. It soon opens up and divides into two branches. The left (N.W.) branch ends in a vertical ice choked chimney. Following the right (S.E.) branch we soon discovered it too ended in an icy chimney. Traversing on small ledges outward and upward to the right we reached the arete and looked down the steep walls into the next chute to the southeast. This chute does not go all the way down to the basins. Continuing the ascent near the arete we found a rotting vein of quartz which provided us a good ledge into the chute. This chute is a chockstone which was easily passed on the left by means of a fourth-class pitch. The top of the chute proved to be a spur off the main crest. The twin summits of Thunderbolt were about two hundred yards due east and upward to the left was the highest point of the crest between Winchell and Thunderbolt. We climbed up to this point and then traversed southeast to the notch between the Thunderbolt summits. The southwest peak is the highest. There is one fourth-class pitch from the notch which takes one to the east side of the peak. Then we climbed around the south side to the summit block. The fifteen-foot block is quite exposed and presents an intriguing rock climbing problem. Only the climbing rope is required to make a perfectly safe and protected lead. In spite of this perhaps less than fifty per cent of those signing the register have reached the true summit of the peak.

We descended to the notch between the summits and then all the way down the chute. We discovered that this was the first chute on the Palisade Basin side of the Dusy-Palisades Basin divide. This chute is third class and is probably the best route up Thunderbolt from either basin. About one-third of the way up there is a narrow chimney choked with chockstones. The chimney can be by-passed on the right side (looking up) of the chute by traversing out on a three-foot scree-covered ledge until the angle lessens and it is possible to work back into the chute above.

OSCAR A. COOK

SPIRES BUTTRESS—N.E. CHIMNEY

From the floor of Yosemite Valley a prominent cliff may be seen to the left or southeast of the Cathedral Spires. The prominent chimney which divides this cliff was first attempted three years ago by Robin Hansen, Morgan Harris, Richard Houston, and me. Our party was stopped by the traditional Memorial Day rain, cold, and what Robin called the biggest overhanging chockstone he had ever seen.

Last August Bill Dunmire, Bob Swift, and I joined forces for another attempt. The route of the previous attempt was followed to the great overhang. This avoids the lower cascade of chockstones by going to the right up a steep staircase to a small tree. This pitch proved more unpleasant when dry than on the wet first attempt. Small ledges covered with loose sand and small gravel offered treacherous footing. From the tree a tricky step to the left around an overhanging corner brings one under a smaller chockstone just below the big one. The use of a couple of slings on the right (looking up) wall enables the leader to gain the ledge under the great overhang.

The great overhang was tackled by starting deep inside on the right hand wall where an angle piton can be placed about twelve feet up. It was a long awkward stretch outward to a good crack and my ribs gave out before another could be

placed. Bob took over and drove one in which just held him until he reached a good handhold farther out. As this piton rattled out, we gleefully urged Bob to traverse out from underneath the overhang and put in a good Salathé spade. I resumed the lead and placed more direct aid pitons in advancing to the lip of the overhang. The thank-god handhold is missing here. With a little direct aid from an insecure piton and some cross pressure I pulled over the top. This pitch is the crux of the climb.

The route then proceeds up a series of smaller vertical or overhanging flower gardens until another chockstone is encountered. This is easily passed by leading up a 100-foot, high-angle open chimney to the right. At the top of this pitch we were benighted and bivouacked for the night tied in to pitons. At five-thirty A.M., we were under way, and two pitches found us on top at seven. We descended by going over the gap to the south and hiking down to the road. The climb took twelve hours from the road, involved thirteen pitches, seventeen pitons, with ten of them for direct aid. It is an excellent climb for hot weather as the entire route is completely shaded.

OSCAR A. COOK

ROCK SLIDE OF THE YEAR

With a thunderous roar and amid a mushrooming cloud of dust tons of rock and rock debris cascaded from the south wall of Yosemite Valley in the vicinity of Sentinel Rock at 1:40 P.M., Sunday afternoon, October 23, 1949. So thick, indeed, was this cloud that it blotted out the sun in the general area of the slide and made it impossible to determine for the time just what had happened. Only as this cloud moved up the valley, rising almost to the top of the walls, was the magnitude of the slide revealed. Dust was deposited in the upper valley.

High on the south wall of the valley, within a hundred or so feet of the top and across the ravine of Sentinel Fall from Sentinel Rock, a huge section of the shoulder of a cliff had broken off leaving a scar of perhaps several acres of loose and weathered rock. The tremendous concussion caused by this slide started a second slide from the west shoulder of Sentinel Rock itself about 1,000 feet from the top.

This latter slide descended to within a few hundred yards of the parking area at the valley terminus of the Four Mile Trail to Glacier Point. About 600 feet of the lower end of this trail was wiped out, as it was covered to a depth of from two to six feet of loose rock debris. Mature trees were splintered or sheared off while still others stood stark beneath the cliff shorn of all their branches. Those trees and shrubs which were otherwise unaffected were heavily covered with a thick coating of rock dust, which would rise in a miniature cloud when the plant was shaken. Dust lay an eighth of an inch thick over the rocks and ground for a quarter of a mile.

It is difficult to determine just what started these rock slides. It is worth noting, however, that at the time of the slides the sun had just crept around to a position which allowed it to shine on these cliffs for the first time that day. It is possible that this warmed the area sufficiently to melt any ice which might have been holding loose rock in place. Or movement might have been started by expansion of the loose rock mass, warmed by the sun.

Whatever the cause, according to old residents, this is undoubtedly the largest and most spectacular rock slide which has occurred in Yosemite Valley during about the last twenty-five years. So spectacular was this phenomenon that a considerable

crowd of people immediately assembled in the general region within minutes after it was first seen and heard—people who were accustomed to numerous rock slides during any year.

Miss Lois Nordlinger has given a vivid eyewitness account. She and Betty Barnard were on horseback in the immediate region at the time of the slides.

"We looked up just as the first rocks were breaking loose from the top of Sentinel Rock. We didn't think too much about it at first, believing it to be just another small slide. We kept watching as we rode along. Suddenly the slide gained momentum and larger boulders were swept down. We stared, hypnotized, our horses tense and trembling. We could see great boulders shearing the branches from trees along the cliff wall; the noise increased, the low rumble was terrifying. Suddenly the foremost part of the slide hit bottom and dense clouds of dust and debris arose. It seemed as if a huge tidal wave were advancing toward us. Within seconds we were completely enveloped, unable to see the trees next to us and obscured from each other. The dust became fiery red, filled with flying sparks caused by the intense friction. There and then we decided we'd better get out of here before we were goners. Simultaneously, we wheeled our horses and raced back to the Old Village, the billowing dust in hot pursuit."*

Another eyewitness account was given by Frank Haddad of Los Angeles. His niece and he were eating a picnic lunch near their car, which was parked near the foot of the Four Mile Trail. Suddenly they heard what they thought was thunder. Looking up they "saw a slide which looked like the firefall." This was quickly followed by a descending cloud of rock dust. When this became so thick that they were afraid they would be smothered in it, they groped for their car, climbed in and in confusion backed the car into a ditch. When the tow car arrived their car was so covered with dust that it had to be taken to the garage to have the dust blown off.

Although the major rock slides occurred on October 23, 1949, numerous slides of considerable proportions continued over a period of several weeks. The area is not yet stabilized and probably won't be for some time to come. It is for that reason that repair of the trail is not to be undertaken until well past next spring.

DONALD EDWARD MCHENRY, *Park Naturalist*
—From *Yosemite Nature Notes*, December, 1949.

ASCENT OF GLASS MOUNTAIN

On May 30, 1949, 26 members and guests of the Desert Peaks Section of the Southern California Chapter made an ascent from the southwest side of seldom-climbed Glass Mountain, elevation 11,127 feet. This is the culminating peak of a small but beautiful range lying east of the Owens River, between the Sierra and the White Mountains, and due east of the Minaret region.

To reach the mountain, the party drove north over a narrow dirt road from the junction of the Benton Crossing road and the Owens River, following the east bank of the river for several miles. The road then left the river, darting eastward to the mouth of a large canyon west of the peak, where it ended. Here, at about 7,600 feet elevation and six miles from the summit of Glass Mountain, the group found a splendid campsite among towering pines and aspens, with a pleasant stream close by.

* *Yosemite Sentinel*, October 29, 1949.

From camp the climbers followed a faint trail up the canyon to the summit ridge, then south along the ridge to the broad sandy summit plateau. Typical Memorial Day stormy weather prevailed, and clouds enveloped the peaks of the Sierra and White Mountains above 12,000 feet. However, glimpses of the lower portions of these mountains indicated that Glass Mountain may afford one of California's most spectacular views. Another point of interest was the great quantity of obsidian, which outcropped in small walls along the route. The group descended one wide chute nearly 2,000 feet in elevation, coal black from small chips of obsidian covering the sand beneath. This chute ended in a talus slope of pure obsidian blocks weighing about a hundred pounds each, which made a tinkling sound under foot. Glass Mountain is indeed well named.

The Desert Peaks Section conducts about a dozen trips each year to the desert ranges, and has found many interesting mountain areas. Members have begun work on a guide to the peaks and ranges of the Basin and Range Province, that vast area which makes up most of the Southwestern United States, and contains about six hundred separately named ranges.

BILL HENDERSON
Chairman, Desert Peaks Section

CLIMBS IN THE PALISADES

Big Pine, California,
March 14, 1950

Mr. David R. Brower,
Berkeley, Calif.

My dear Dave:

I received your letter relative to Mountaineering Notes for climbs during the past year. I make a number of more or less routine climbs every year, but have not done much original climbing for some time, and last summer did nothing after early July because of an injured foot.

However, together with John D. Graham, I made a traverse of the North Palisade, ascending it from the north by the U Notch and descending it by the LeConte Route. Probably this was the first time that this had been done. It was, however, an accident—we did not reach the summit sufficiently early to be able to get off the mountain before nightfall by returning by the route through the U Notch.

Owing to a succession of relatively light winter snowfalls, climbing conditions in the Palisades have changed considerably from those usual during years of normal or greater precipitation. For one thing, by the middle of July, or even earlier, more or less glare ice is exposed in couloirs up which ice tongues extend. This is true of the U Notch couloir and even more so of the very large one on the western end of the North Palisade. It is true also of the chute or twin ones leading up to the notch between the Thumb and the Middle Palisade—Southfork Pass. Although relatively easy, even for backpacking during a year of normal or greater snowfall, during the past several ones more or less glare ice has been exposed by the middle of July. The rock, also, about the head of these chutes is so jointed and friable that at least once during the season a big rockslide comes crashing down. One does not only not know when these may occur—although it is usually mid-season or later—but also they leave a considerable number of rocks, large and small, strewn around with such an unstable equilibrium that it requires very little in the way of suggestion—sometimes merely

a heavy puff of wind—to cause them to continue down the chute in a bounding, ricocheting course, which is sometimes difficult to sidestep.

In other couloirs, the amount of snow has decreased so greatly that what are, during normal or greater-than-normal snowfall years, combination snow and snow-and-ice climbs, are in present conditions by mid-July more or less climbs of rock and ice.

In these couloirs obstructions may occur which during heavy snowfalls are entirely covered. This is true of the Underhill Couloir—the farther to the right of the two leading up to the deep col immediately east of Thunderbolt. About two-thirds of the way up, the floor of this couloir is blocked by a large chockstone. It may be possible to flank this to the left, but such holds as occur are slope-down ones and none too secure. To the right of the rock, however, there is a wall about twenty-five feet high, which although not very far from vertical—about 70°—has a sufficiency of good hand and foot holds to render it easily scalable to a point above the chockstone. Between the latter and the col the climbing averages about class # 3. By mid-July it is mostly rock, but there may be more or less ice.

The big ice-filled couloir immediately to the west of the great buttress or shoulder running up from the glacier requires, by mid-July at least, a good deal of caution on the part of climbers, as rocks are in the habit of ricocheting down it in a very dangerous fashion. Either in ascending or descending, however, the bergshrund can usually be crossed at a point only twenty feet or so to the right of the eastern margin of the lower end of the couloir. One can, in ascending, swing to the left, and cut steps along the base of the left walls until accessible ledges appear on the latter—a matter of only about thirty yards—all the while being protected from ricocheting rocks by an outward bulge in the wall a short distance above. In descending, one follows along the ledges low down on the wall until they terminate, and then takes to the ice. In ascending, within a hundred yards or thereabouts, one can leave the ledges, and pick a way upward and eastward—climbing mostly class 2—to the crest of the great shoulder. To the east this crest drops away sheer for upwards of a thousand feet. Early in the season one may trust himself to snow slopes to the west, but later these may be hazardous from the possibility of their sloughing off and giving one a free and rather expeditious ride down to the glacier, at which point he might possibly still be intact, but probably would be otherwise.

The crest soon becomes a narrow but in no place a really difficult blade. Persons with unsteady nerves should, however, have a rope attached to them. When difficulty eventually appears directly ahead, one can readily traverse obliquely upward and to the right to a small col in the main crest of the mountain. From the latter he traverses to the left around a shoulder and into a couloir, at the head and to the right of which stands the final gendarme of Thunderbolt.

The ascent of Thunderbolt via the Underhill Couloir route and descent by the "ridge route" col—the lower end of the big ice couloir—or vice versa, affords a very desirable traverse. Of the two alternatives, the ascent by the Underhill Couloir is perhaps the preferable one.

By mid-July it may also be difficult in places to cross the bergshrund of the North Palisade Glacier. The portion of it directly below the U Notch can probably always be crossed, but with greater difficulty than during years of heavier snowfall. The stretch of bergshrund immediately below the North Face Route up the North Palisade is sometimes impassable. Two hundred yards or so of open crevasse in late sum-

mer sometimes blocks the direct way to the routes up Mount Sill from the northwest. Bridges, however, can usually—perhaps always—be found along the left margin of the lower end of the large couloir running up toward Mount Sill. There is more loose rock in the various routes up to the crest of the Sierra immediately west of Mount Sill than was the case when there were more storms and snow to sweep them off.

More ricocheting rocks and rockslides come down the Palisade than was the case when there was more snow. These are rather numerous in the latter half of July and are still numerous in August. They are most common also in the afternoon, but may occur at any time—even early morning. At five o'clock in the morning one day last August, for instance, a tremendous rockslide swept down the east face of Mount Agassiz, making a noise like thunder. Slides are most frequent, however, on the North Palisade, west of the great ice couloir.

In July a number of other Sierra Club people and I climbed Mount Gayley by ascending the rib immediately to the right of a couloir leading up to the large col running southward from Mount Gayley, to a point near the base of the col. Perhaps 200 feet below it we traversed to the left and upward to the foot of the arête leading up Mount Gayley, the arête being followed to the top of the mountain. On the approach to the arête portion of the climb is a little class–3 rock work. There appeared to be several alternatives on this portion of the route. This affords a rather direct route up Mount Gayley, a very enjoyable climb, and the summit is perhaps the best vantage point to view the contiguous basins in the head of the North and South forks of Big Pine Creek.

I have descended the southwest face of Mount Gayley from points well up along the arête, once without rappelling, roping down the other time with several rappels of thirty or forty feet.

The snow in this portion of the Sierra is about the same as this time last year. I have made several ski trips up to 11,000 feet and over during the past months, and am planning more, but with the road open it is somewhat difficult to get away from the lodge.

Very truly,

NORMAN CLYDE

Reviews

UP AND DOWN CALIFORNIA in 1860–1864. The Journal of William H. Brewer. Edited by Francis P. Farquhar. University of California Press, Berkeley, 1950. Second edition. 583 pages, illustrated. Price $6.50.

This second edition of William Brewer's Journal, "reissued in substantially its original form," will be cordially welcomed by our historically-minded members, inasmuch as the first edition, published in 1930 by the Yale University Press, has long been out of print. The original edition was published in two printings of 1,000 copies each, which did not go very far toward taking care of the steady demand which has continued through the years. We are very fortunate that the University of California Press was inspired to reprint this valuable book, and that the Brewer family and the Yale University Press gave their consent.

The reprinting is by offset lithography, a photographic process, which renders it exactly the same as the original as far as the text is concerned. There are a few changes otherwise—the itinerary taken out, and a slight reduction in illustrations, but everything of significance remains.

And almost everything in the book is of significance. It is hard to pick out any part of it that is not interesting reading. Brewer was a great letter writer and kept a careful diary, and his notes were detailed, systematic, and extremely accurate. His journals and letters are lively and full of graphic descriptions of people and places. Because he was not only accurate and a good observer, but was also able to record his impressions vividly, his journals are of great value as a picture of the experiences and accomplishments of the California State Geological Survey, and of many other aspects of California at this time.

When in 1860 the California State Geological Survey was established and Josiah Dwight Whitney appointed State Geologist, the first man he selected for his staff was William H. Brewer. Although at the time he did not know him personally, it turned out to be a very fortunate selection. To quote Professor Russell H. Chittenden, of the Sheffield Scientific School at Yale, in his preface to the 1930 edition: "Not only was Brewer thoroughly equipped for the several lines of work he pursued throughout his long life, but in addition he possessed a personality which gave added strength and vigor to all his efforts. A close observer, a careful and sagacious thinker, slow to arrive at a conclusion until all the facts were available, he embodied all those attributes that contribute to success in the conduct of any investigation that calls for wise judgment and logical reasoning. As these letters show, even in his younger days, at the time when he became 'principal assistant' in this survey of California, he it was who had the knowledge and the power to take charge of and carry through a scientific enterprise, under conditions far from favorable, and without doubt such success as the survey attained was due in no small measure to his resourceful leadership in the field."

It is an important book historically, as it gives a picture of post-gold-rush California, up and down the whole state, the valleys, the coast and the mountains, which has added greatly to the knowledge of a rather neglected period of California history. The first edition was reviewed by John R. White in the *Sierra Club Bulletin* for February 1931, and his final paragraph sums up what applies in every way to this second edition.

"The book is happily titled, the journals are happily written, and as happily edited. The illustrations, chosen from contemporaneous photographs, sketches, and prints, help to convey an atmosphere of early California men, scenery, and activities. The illuminating, but not intruding, notes at each chapter end are of the greatest assistance to an intelligent understanding of the book, providing information without interrupting the continuity of the narrative. In fact, the editing, general composition, and appearance of the book leave nothing to be desired." M. R. P. AND H. T. P.

BEHOLD THE MOUNTAINS: CLIMBING WITH A COLOR CAMERA. *By Frank S. Smythe. Chanticleer Press, New York, 1949. English title,* MOUNTAINS IN COLOUR. *Max Parish & Co., London, 1949. Illustrated by 57 photographs in color. 155 pages. Price $5.00.*

This is the last of Frank Smythe's twenty-three books on the mountains. The fifty-seven excellent, full-page color reproductions cover mountains from Everest to the hills of Vermont, and are accompanied by a text that blends facts and vignettes concerning the various mountain areas with glimpses of the mountaineer's attitude toward the hills.

Smythe had a busy life and could not get everywhere, and we miss the pictures of the Tetons and the Sierra Nevada that we feel should be in a group of mountains of North America. But even with such a scattered group of views of American mountains, the book is an excellent collection of beautiful photographs, giving the reader a vivid and lasting impression of the beauty of mountains in color.

ALFRED W. BAXTER, JR.

THE EARLY ALPINE GUIDES. By Ronald Clark. Phoenix House, London, 1950. Illustrated, and with four maps. 208 pages. Price 15 shillings.

This is a work in the best tradition of alpine historical scholarship. Vast material from early *Alpine Journal* accounts, unpublished diaries and *Fuehrerbucher* and rare editions of early Alpinismus have been skilfully worked into a well-rounded story of the origins of a sport and the birth of a tradition.

The book is much more than a routine history and biography of the early guides. Out of the detail of these men's lives Mr. Clark develops a picture of climbing from the early mountaineering, incident to scientific studies in the Mont Blanc area, to the days when amateurs first regarded the Alps as "played out" and set off for distant ranges with their Swiss guides, to extend the sport to the other great ranges of the world.

Materials for the guides' biographies are scattered and hard to organize. It is a great merit of this book that the writer succeeds in presenting so clearly the part of the guides in the pioneering days of climbing. Mr. Clark also describes the growth of the guides' associations and societies which gradually established a tradition and standard among the guides to parallel the influence of the mountaineering clubs on the amateur climbers. ALFRED W. BAXTER, JR.

THE VOICE OF THE COYOTE. By J. Frank Dobie. Illustrated by Olaus J. Murie. Little Brown & Co., Boston, 1949. 385 pages. Price $4.00.

In the saga of his way of life Señor Coyote is fortunate in having a chronicler as friendly as Mr. Dobie. In his preface the author writes, "I confess to a sympathy for the coyote that has grown until it lives in the deepest part of my nature."

This statement suggests the kind of book he has written. For a generation Mr. Dobie has collected his voluminous material, and has examined all available scientific knowledge concerning the coyote; but of equal importance and vastly more colorful is his own contribution, and the experiences of ranchmen, cowboys, and amateur naturalists.

The coyote's impact on humanity is reflected in the important role he plays in the Indian pantheon of Nature Spirits. He dominates endless folk tales and superstitions of the American and Mexican Indian; a classic example is "Zuni Folk Tales," by Frank Hamilton Cushing. This little jester has the reputation of being a predator and a rascal, yet the author quotes a former Chief Biologist of the National Park Service: "Throughout the ages the coyote has helped to weed out the unfit and keep the survivors alert."

Anyone who under a desert moon has thrilled to the song of the coyote, or who at dawn in a mountain meadow has marveled at his wild hymn to the rising sun, will feel that the wilderness without this uncanny little singer has been tamed. Don Coyote is sadly in need of friends if he is to be spared the fate of the buffalo. All wilderness lovers will welcome this book as an influence toward a better understanding and appreciation of wild-life values by a public all too often careless and indifferent.

The illustrations by Olaus J. Murie are calculated to make such friends; they show this ventriloquist singer in all his moods, both at work and at play. The author's notes at the end of the volume supply evidence of the richness and variety of the material he has woven into this fine book. RALPH MOCINE

THE GREAT NORTHWEST. By Oscar Osburn Winther. Alfred A. Knopf, Inc., New York, 1947. 383 pages, illustrations, maps. Price $4.50.

Thoroughly readable as well as scholarly, authentic, varied, and complete, is Oscar Osburn Winther's *The Great Northwest,* the latest and, according to some, one of the best histories about a beautiful and important region once known in general as the Oregon Country. Dr. Winther begins his story with chapters about the various tribes of Indians that inhabited the Northwest and the earliest visits of white men. Next he takes up the story of fur-trading, and then the period of settlement when the great caravans of covered wagons set out from Independence or St. Joseph, Missouri, to follow the famous Oregon Trail to the new frontier.

Following sections deal with the development of government, transportation, agriculture, lumbering, education, literature, art—and of course the Northwest came in on the gold rush, too. The last part of the book takes up the story of reclamation projects and industrialization. After discussing political, labor, and migration trends and the growing city consciousness, Dr. Winther, in the closing pages, takes "time out for culture," and then concludes with a statement, with which anyone who has lived up north, as has Dr. Winther, will agree, that "most people in the Pacific Northwest possess a deep and sincere regard for their region. The great and beautiful outdoors is thrust in upon them and they love it . . . they harken to the call of the open road, the sparkling streams, the moody waters of the Sound, the towering green mountains, the inland deserts, and the hundreds of lakes and thousands of favorite scenic spots which Nature has so generously bestowed upon this—the 'farthest reach' of the U. S. A." The book is attractive in appearance and includes interesting illustrations, useful maps, and a comprehensive bibliography. B. S.

CAMPING CAN BE FUN. By Robert W. Weaver and Anthony F. Merrill. Harper & Brothers, New York, 1948. 242 pages, illustrated. Price $3.00.

This book is fun, too. The stranger to camping will be encouraged by it to try; the novice will feel reassured that he has made a good start. The experienced camper will find helpful suggestions as well as confirmation of much that he himself has learned, and even the expert will see little to criticize. The humorous attitude of the authors is balanced by their really practical knowledge of the subject. They give intelligent advice to the hiker and knapsacker, but have a kindly word for the automobile camper as well. Especially valuable are the many references to the adaptation of surplus army equipment to peacetime outdoor living. Here is an informal, up-to-date handbook which points the way to easy and enjoyable camping. V. S.

WHITE SANDS. Ten original photographic prints by Brett Weston. Foreword by Nancy Newhall. Typography by the Grabhorn Press, San Francisco, 1949. Published in an edition of 50 copies by the photographer, Carmel, California. Price $75.00.

It is of great importance to all of us when a fine creative artist turns to the natural scene for source material; especially so when his subject relates to the national parks and monuments. Conservation, as a living experience based on an emotional response to nature, and practiced as a contribution to the progress of society, requires the exploration and interpretation that only the revelation of art can provide.

A vital concept of the importance of the natural scene cannot be erected on the usually dry and conventional aspects of conservation in everyday application. Here we have a sequence of images which make deep penetration beyond the surfaces of nature and the mannerisms of art. The incredibly beautiful forms of the gypsum dunes and the delicacy of the plants growing upon them, all glowing under the desert skies, make the White Sands National Monument in New Mexico a region of extraordinary interest and beauty. The photographer has conveyed these qualities with craftsmanship and taste. His work is notable for its subtle combination of power and delicacy, its expressive sincerity and magnificent technique. As in all creative art the additional dimensions of imagination and spiritual perception pervade this work. It is a notable example of photographic interpretation of the natural scene.

Brett is the son of Edward Weston and is rapidly assuming his place among the leading creative photographers of our time. This portfolio is his most important work to date. His prints are exquisitely finished and mounted on the finest Strathmore boards. A notable foreword by Nancy Newhall reveals the qualities of the man and his work. The text material is beautifully printed by the Grabhorn Press, and a simple firm portfolio case in gray fabric completes and unifies this most excellent work of art. ANSEL ADAMS

ALEXANDER McADIE: SCIENTIST AND WRITER. Fifty-four articles and essays, letters, memoir and bibliography, etc. Compiled and published by Mary R. B. McAdie, Charlottesville, 1949. 421 pages.

Alexander McAdie, who was Vice-President of the Sierra Club 1904–1913 and Honorary Vice-President 1913–1917, is shown in this collection of his writings to have had wide and varied interests, but the chief one was aerology, his chosen profession.

As a meteorological physicist he was Forecast Official, 1895–1902, Professor in Charge, 1902–1913, of the United States Weather Bureau, San Francisco, and Professor of Meteorology, 1913–1931, at Harvard University, and Director of Blue Hill Meteorological Observatory.

This book, presented to the Sierra Club by Mrs. McAdie, will be of special interest to Sierra Club members because many will remember Professor McAdie well. It is well for the Sierra Club to have this volume in its library, so we will not forget another one of the outstanding men whose contribution to the club's past has helped make the club what it is now. H. T. P.

SIERRA-NEVADA LAKES. By George and Bliss Hinkle. The Bobbs-Merrill Co., Indianapolis, 1949. 383 pages. Photographs and diagrammatic maps. Price $4.00.

Admittedly mistitled, this fascinating book is actually a narration of historic incidents centering around a few lakes east of the main ridge of the Sierra, from Honey Lake on the north to Mono on the south. No apology is needed, however, for this effort to appeal to larger numbers of readers by means of an attractive title, as anyone interested in the wilderness or local history will enjoy this book for what it is—a straightforward, unromanticized recounting of major local historic events spiced with a wealth of minor anecdotes and legends.

The history of the gold and silver mining era is a chronicle of unfettered exploitation of timber, water, wildlife, and natural beauty. This description of laissez faire in its heyday tells of the wild speculation, waste, and financial manipulation which made many of the great fortunes of the West. The authors present the conservationist's viewpoint throughout the book, but especially effective is the conclusion, which summarizes the waste of resources which began with the gold rush and is continuing now.

Some of the greatest pleasure to be gained from this book comes from the accounts of humorous trivia such as miners' hoaxes and antics. Also valuable are biographical notes about prospectors and pioneers such as Snowshoe Thompson, Peter Lassen, Isaac Roop, Lucky Bill Thorrington, Caleb Greenwood, and Samuel Clemens. There are also dramatic episodes of duels, Indian wars, shootings, claim jumps, and vigilantes. The development of recreational areas is covered in detail from good Doctor Webber's sylvan haven of the 1860s to the Coney Island attractions of the modern Tahoe. ROBERT A. BREWER

COUNCIL FIRES. By Ellsworth Jaeger. The Macmillan Co., New York, 1949. 253 pages. Illustrated. Price $2.95.

Ellsworth Jaeger gives us the history and development of outdoor fires and shows us how an ordinary campfire can be turned into an interesting and authentic bit of tribal pageantry. He cleverly integrates primitive customs and rituals with modern showmanship and brings forth well organized ceremonial programs to catch the eye and heart of any young woodsman. The adult campfire leader also will find plenty of authoritative material for his maturer programs.

In the camp library this little volume will prove a ready and complete reference work covering the history and technique of firebuilding, of songs, games, contests, a wide variety of dances together with the accompanying paraphernalia of masks, body painting, costumes, fans, banners, coup sticks, and musical instruments. It is thoroughly illustrated with 117 full pages of sketches. OLIVER KEHRLEIN

AMERICAN HEARTWOOD. By Donald Culross Peattie. Houghton Mifflin Company, Boston, 1949. 307 pages. Price $3.50.

The story of the trees of this country, the estimated eight hundred and twenty million acres of them that lay behind the dark forest wall that confronted the discoverers of the New World, and what has happened to them is indeed amazing, often thrilling. If it should ever seem, however, more sad than thrilling, if, as Donald Culross Peattie says in *American Heartwood,* we should grieve for that "primeval beauty" that we will never see, we must remember that "if it were here, we would not be." And what is it that is here in place of that wilderness, that heartwood, that is not here? According to Mr. Peattie, it is another kind of heartwood, a heartwood tough and sound; it is "a country which grew straight up from one idea, and that the best one."

To show why he feels that this country's heartwood is sound, Mr. Peattie takes us back to that primeval wilderness and then, coming up through the centuries, we see what men have done to the trees of that wilderness and what the trees have done to the men, how "men and trees are partners in the American story." It is not a complete story of the trees, nor of the men. That would fill many volumes. It is rather a series of brief stories beautifully written, and well described by the author where he says, "When you choose standing trees for timber, or men to represent, by their lives, your country, you make your blaze on only the straightest and the soundest."

Among these men straight and sound are the Norsemen, Columbus, John Smith, Roger Williams, William Penn, John Marshall, and "Old Hickory." One of the deeply moving stories is the one about Valley Forge, entitled "Valley of Fortitude"; and one of the most thrilling and stirring is the one about the *Constitution* with her "ironsides" of toughest live oak, "Heartwood Afloat." There are also tales about the Santa Fe Trail, the Comstock Lode, the great prairies "Where No Trees Grow," as well as quieter portions about home and hearth, and the brilliant autumn coloring found in the forests of America.

The concluding chapter, "The Pine Tree Badge," touches briefly upon what men and trees are doing together and for each other today in America; how the idea of conservation was advocated in the very early days of our country but went unheeded for so long, while forests were being annihilated because there was no one to protect them and the people simply couldn't believe that they were not inexhaustible. It shows what the Forest Service is doing to aid in the wise use of what remains of the eight hundred and twenty million acres of trees.

Mr. Peattie confesses that *American Heartwood* is for him a holiday; that he is journeying where fancy takes him, putting in what pleases him and leaving out whatever he doesn't care to be bothered with. In view of this, it is not at all surprising that the book turns out to be uplifting, heartening, and strong on inspiration.

B. S.

TWO MOUNTAINS AND A RIVER. By H. W. Tilman. Cambridge University Press, Cambridge, 1949. 233 pages. Illustrated by 83 photographs, 6 maps. Price $3.50.

The two mountains are Rakaposhi (25,550 feet) near the northwestern end of the Karakoram, and Muztagh Ata (24,388 feet) southwest of Kashgar in Sinkiang. The river is the Oxus in northern Afghanistan. The book covers the spring, summer and

fall of 1947, and describes attempts on these two widely separated peaks and a long walk back to India via Afghanistan, where the author, without proper passport, spent some time in local jails.

The Rakaposhi expedition was made in the company of two Swiss climbers, Hans Gyr and Robert Kappeler, and Campbell Secord who had visited the peak in 1938. Shortage of time, a series of minor accidents (everyone in the party, except Tilman, seemed to keep stumbling and spraining ankles) and sheer difficulties with deep, fresh snow halted the ascent at a little over 21,000 feet. After this attempt was abandoned the party split up to go various ways.

The remainder of the book deals with Tilman's subsequent journey to Kashgar to visit his old Everest colleague, Eric Shipton, the British consul there; with their attempt and failure on Muztagh Ata; and finally with Tilman's long solo walk across little-used passes into Afghanistan on his way back to India.

ALFRED W. BAXTER, JR.

THE CASCADES: MOUNTAINS OF THE PACIFIC NORTHWEST. Edited by Roderick Peattie. The Vanguard Press, New York, 1949. Illustrated by photographs. 417 pages. Price $5.00.

The latest book in the American Mountain Series has been treated in the way that has become familiar to the readers of the series. The editor has asked an authority on each aspect of the range to write a chapter from his or her special knowledge and experience. There is naturally a little overlapping of some of the subjects, but not enough to trouble the reader.

We learn of the people living in the mountains at the "last frontier" from Margaret Bundy Callaghan, who lives a good part of the time, with her family, on a farm in the Mount Pilchuck region. We discover that in these areas it is the mountains that mold the men who live there, not the men who mold the mountains.

Writer and mountaineer, interested especially in the history and geography of the region, Grant McConnell gives us a clear, brief picture of the discovery of the range and the general lay of the land. He has also contributed the chapter on mountaineering, and tells some lively stories of the early ascents and the later developments of the sport.

Although we think of Weldon Heald as a Californian and ardent Sierra-Nevadan, and although he now lives in Arizona, he is well equipped to write of summer holidays in the Cascades. He has spent many summers there, climbing, hiking and exploring, and he succeeds in taking us on a pleasant and interesting holiday among some of his favorite mountains.

Climbing down from our mountain journey, we enter the world of logging and mining, so important in the history of the Cascades. And who could describe these activities better than James Stevens, one of the most successful interpreters of Paul Bunyan.

Walter McCulloch, professor of forestry at Oregon State College, was a logical person to write of the trees of the Cascades, and those magnificent forests which clothe the lower reaches. He takes us from the shade of the forests to the highgrowing hemlock and alpine fir. Professor McCulloch explains too, the management of the forests by the Forest Service and the practice of proper forestry methods by private owners.

The flowers of the forests and of the alpine meadows, and the birds, which are harder to know and to see, but no less a part of the mountains, are given a chapter each. Harry W. Hagen, though not a professional botanist, for many years has studied with his wife the plants of the mountains—all because it rained on the climbing trip they planned for their honeymoon, and so they collected and studied the flowers instead; a hobby which has become stronger each year. Ellsworth D. Lumley, a teacher, was a ranger naturalist for a number of years, and has always been interested in birds. He seems to have an amazing capacity for enticing them to come when he calls or beguiling them to go about their business with little fear.

No book about the Northwest would be complete without a fisherman holding forth, and Herbert Lundy, who has fished the rivers from the Rogue to the Skagit, describes most tantalizingly the rivers and the lakes to be found up and down the Cascades. Nor can the sport of skiing be overlooked. Charles D. Hessey, Jr. knows the Cascades in winter as well as in summer, and grows lyrical over the opportunities for every kind of skiing experience offered by them. Ski mountaineering is to him the chief joy of skiing, and there are miles and miles of Cascades to explore in that way.

It is a pleasant book to read, especially for those who are familiar with some of the areas described; and the enjoyment is enhanced by the many attractive photographs with which it is illustrated. H.T.P.

ADAPTATION AND ORIGIN IN THE PLANT WORLD. By Dr. Frederick E. Clements, Dr. Emmett V. Martin and Dr. Frances L. Long. The Chronica Botanica, Waltham, Mass.; J. W. Stacey, San Francisco. 331 pages, illustrated. Price $6.00.

Sierrans, curious about the wide variations in their mountain flowers, will find in this monograph the important role played by light, heat, cold, drought, moisture and soil texture in the modification of our plant life.

Dr. Clements and his associates, over a period of 40 years, transplanted thousands of specimens from one elevation and medium to another, in their experimental gardens on Pike's Peak at 8,000 feet elevation and at Santa Barbara at sea level. Thus they were able, during less than a half century, to speed up the slow and uncertain process of thousands of years of adaptation and evolution in their relation to environment. For the scientific botanist, this book will prove a valuable source of unpublished data on experimental ecology and morphogeny. OLIVER KEHRLEIN

MOUNTAIN PROSPECT. By Scott Russell. Chatto and Windus, London, 1946. xvi + 248 pages. Price $5.00.

As Geoffrey Winthrop Young states in the foreword to this book, "If any one of us had sat down as a boy to imagine the ideal fairyland to which he wished to be transported, he will never have pictured anything more satisfying than that first coming of this small boy into an unknown world of hills, rivers and forests." Thus was Scott Russell, at an early age—when his family moved from England to New Zealand—introduced to the hills and mountains; mountains which for the most part were unexplored. As he grew older and wandered farther and farther afield, a knowledge and love of these hills grew with him—a love which comes only to those who have spent many hours toiling on their peaks and exulting in their glory.

Scott Russell is a mountaineer in the true sense. He was trained as a botanist, but I suspect that he followed this field primarily to enable himself to be among the hills

and mountains. He is successful in including them in his plans: the New Zealand Alps, the Welsh and Scottish hills, the European Alps, Jan Mayen Island in the Arctic, and finally the Karakorams with Eric Shipton. What more could a mountaineer want?

The book should have a wide appeal for other than mountaineers. Because of Scott Russell's rare ability for portraying what he sees and feels, and for sharing with us his experiences and his love of the mountains, his book approaches great literature.

PHILIP C. BETTLER

MY CAMERA IN YOSEMITE VALLEY. By Ansel Adams. Virginia Adams, Yosemite National Park, and Houghton Mifflin Co., Boston, 1949. 24 photographs. Price $10.00.

All lovers of the mountains, and particularly the many who are familiar with Yosemite Valley, will enjoy this book. There are pictures for every taste, from broad landscapes to intimate details of the natural scene, taken at every season of the year, and maintaining the high standard of excellence we associate with Ansel Adams's work. The publishers and Mr. Adams are to be congratulated on the splendid reproductions.

The pages are large—12" x 14½"—and the plates average about 7" x 9" in size. The book has a spiral binding, so that it will lie flat when opened, and also so that individual plates can be removed for framing without injuring the book.

There is a foreword giving a brief description of the beauties of Yosemite, and opposite each plate is a short discussion of the esthetics of the subject matter, together with an analysis of the photographic problems involved in achieving the effect desired. Included are details of lens and filter used, as well as of film, exposure, development and printing. These should prove most helpful to the amateur photographer, who seldom knows what his picture will convey until he sees the final print.

Following the pictures is an admirable essay on mountain photography, particularly as applying to the Sierra. The sections are concise and easy to follow, and cover such topics as light intensities and the determination of exposure, lenses and filters, orientations, color photography, and motion picture cameras. Included are recommendations for the photographic treatment of the principal points of interest in Yosemite Valley.

The only adverse criticism is that the plates are a little large to look at comfortably when the book is held in the hand, and the limp covers make it difficult to prop up the book for viewing at a distance and render it more perishable.

CHARLES T. TOWNSEND

MARIN FLORA: Manual of the Flowering Plants and Ferns of Marin County, California. By John Thomas Howell. Photographs by Charles T. Townsend. University of California Press, Berkeley, 1949. vi + 324 pages. Price $4.50.

While technical botany is not to everyone's liking, anyone who reads the appropriately lengthy introduction to *Marin Flora* will be armed with abundant information and selected statistics that will enable him to enjoy more fully every visit to Marin County.

This introduction discusses the many land types—grassland, salt marshes, chaparral, etc.—that make it possible for this relatively small county to support 1,452

species and varieties of plants in their natural state. There are lists of the plants that clothe each type of earth (with many excellent illustrations) and a section dealing with the effect of fire on certain plant structures. Other portions of the introduction offer interesting supplemental tables of various kinds of plant associations and occurrence of endemic species, and there is a most informative discussion on the effect of the Golden Gate on plant distribution.

One can judge the great amount of plant collecting and data study that accompanied the preparation of such a book as this, by noting the abundant use of specific place names to describe the distribution of each species. It makes the necessarily technical botanical key a warm and friendly one to those who know Marin as the hiker does. The author, who is curator of Botany at the California Academy of Sciences, is well equipped to provide a botanical handbook for hikers in Marin County, as he has been a hiker as well as a botanist for many years. The convenient size of *Marin Flora* recommends it to those who travel by trail, as well as to those whose homes are in this bountiful county. RICHARD G. JOHNSON

THE FIRST TRANSCONTINENTAL RAILROAD. By John Debo Galloway. C. E. Simmons-Boardman, New York, 1950. x + 319 pages. Illustrations, bibliography, index, end-paper maps. Price $5.00.

This book, a valuable addition to the literature dealing with railroading in the United States, is the outcome of a civil engineer's hobby. A native Californian, John Debo Galloway, after graduation from Rose Polytechnic Institute and brief employment on the Great Northern Railroad, returned to California where he became recognized as one of the state's great civil engineers. In the course of practicing his profession he developed a burning interest in the early history of the West. Particularly was he fascinated by the dream of the engineer, Theodore Dehone Judah, who envisioned a transcontinental railroad, and also by the multifarious work involved in its inception and development. In a fine engineer, whose hobby was the early development of the western United States, was concealed the meticulous and careful research scholar, whose historical studies led him to trace in person the route of the first transcontinental railroad and to evaluate in his notes the problems of its origin, progress and completion. Both Southern Pacific (the successor to the Central Pacific) and Union Pacific Railroads gave him all assistance in hunting out information and generously put their archives at his disposal. The result of his labors is an admirable, comprehensive and readable study, beginning with the historical background of railroading in general and ending with the driving of the golden spike that joined Central Pacific and Union Pacific at Promontory, Utah, on May 10, 1869.

Between these limits Mr. Galloway deals with the earliest suggestions for a railroad across the United States to the West Coast. He discusses the early projects concerning such an undertaking and the Pacific Railroad Surveys. He presents thumbnail sketches of the originators and builders of the Central Pacific and the Union Pacific Railroads. He traces the location and construction of each line, dealing in the first and larger portion of his book with the Central Pacific and in the latter portion with the Union Pacific Railroad.

Because of his own engineering training and ability Mr. Galloway had an intimate appreciation of the difficulties and problems that beset the locators, designers, organizers, promoters, financiers and builders of the first transcontinental railroad; and

he wrote about them with the sympathetic understanding of a professional man who, in the course of his own career, was obliged to meet and deal with similar ones. He has managed to make the story of their herculean efforts so vivid that the reader is led to wonder whether in this day of private and corporation income taxes enough private risk capital could first be found and then be interested in so uncertain and gigantic, yet so necessary an undertaking for the nation's welfare.

Although *The First Transcontinental Railroad* does not directly concern the traditional aims and interests of the Sierra Club, the particular attractiveness it will have for Club readers is contained in the two chapters: "Locating the Central Pacific Railroad" and "Constructing the Central Pacific Railroad." The territory covered is that of the approach to Donner Pass and the Donner Pass and Truckee River country, dear to every member and especially to the skiing section of the Club. Also Theodore Judah, as delineated, impresses the reader as the type of mountaineer the Sierra Club would be proud to count within its ranks.

After reading this volume, one feels with Sierra Club member Walter L. Huber, who wrote the preface, "that these studies, begun as one of the author's avocations, should be made available to the general public as well as to the engineering profession."

HELEN C. DE FREMERY

SEQUOIA AND KINGS CANYON NATIONAL PARKS. By John R. White and Samuel J. Pusateri. Stanford University Press, Stanford, 1949. xvii + 212 pages. Price $3.00.

This is an excellent and very thorough guide book to the Sequoia and Kings Canyon National Parks, particularly for the lower elevations. The parks are described in detail. First, the historical background, an account of the discovery of the sequoias, and of the various men who were instrumental in having the national parks created. Secondly, by far the major portion is devoted to a detailed description of roads, trails, points of interest throughout the sequoia-forested areas, with mileages, elevations and information on hotel accommodations, camping sites, pack outfits, picnic grounds, etc. A brief portion is devoted to the wilderness area of the high country, especially the Kings River Canyon, and though it is to be regretted that more space could not have been given to this region, it would be necessary to write another book to deal with it adequately.

Colonel White was Superintendent of Sequoia Park for twenty-five years and concurrently was active head of Kings Canyon Park during the war and postwar years. Mr. Pusateri has been ranger and naturalist in both parks. No one has a wider knowledge or a greater love for the parks than these men, and their descriptions of the many scenic beauties and charm of this region will be an invaluable asset to the motorist and camper.

HELEN LECONTE